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MICROWAVE MEASUREMENT SYSTEM

Operation & Maintenance Manual

THE NARDA MICROWAVE CORPORATION • HAUPPAUGE, NEW YORK 11788

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SECTION I

MICROWAVE MULTIMETER DESCRIPTION
NARDA Model 7000A and 7000A-01

1.1. INTRODUCTION

This manual, containing operation and maintenance instructions for the Model 7000A and 7000A-01 (battery powered) microwave multimeter designed and manufactured by Narda Microwave Corp., Hauppauge, N.Y. 11788, is divided into six sections. Section I presents a general description of the equipment including specifications, Section II covers operation, Section III describes theory of operation, Section IV gives maintenance procedures, Section V itemizes replaceable parts, and Section VI contains schematics and parts location drawings.

1.2. DESCRIPTION

The Narda Model 7000A microwave multimeter with an associated microwave unit provides a full microwave measurement laboratory in a small portable unit. Measurements of VSWR, return loss, power, insertion loss, gain and reflection coefficient can be made precisely and automatically with this instrument. It can also be used as a CW or swept signal generator and as a DC voltmeter. The Model 7000A is used equally well for field service with the battery (-01) option or in a computer controlled system using the IEEE-488 interface (-02) option. Microprocessor control has resulted in a system that an inexperienced operator can use to make complex microwave measurements. When a measurement is selected, the multimeter guides the user through an easily understood calibration procedure with instructions displayed on the front panel liquid crystal display (LCD). These instructions as well as those found on a reference card on top of the unit will provide all the required operating procedures for the microwave multimeter. Once the required calibration is complete, the operator is instructed to connect the device under test to the system. By following these instructions his required measurement will be performed. Measurements can be made at a single frequency point or at as many as 52 points over a selectable frequency band. With an external oscilloscope, a swept display is available for tuning a device or determining if any resonances are present.

1.2.1. Power Measurement. The multimeter measures RF and microwave power over the dynamic range of -50 to +13 dBm and over the frequency range of 10 MHz to 18 GHz. When measuring power, the detector is used as a conventional power mount. A zero-bias Schottky diode is used as the detector element for best sensitivity and reduction of zero drift with temperature. At higher power levels, the detector is digitally linearized by the microprocessor, thereby eliminating the drift associated with conventional segmentation circuits. This results ultimately in the long-term stability of the instrument. Power level may be displayed in any one of two modes: dBm or watts. The operator is free to change from either of these modes without recalibrating. Refer to Figure 1-1 and note the buttons enclosed within the "POWER" bracket. After zeroing itself, the multimeter leads the operator through any required calibration process (by displaying instructions on the LCD readout) before making measurements.

1.2.2. Insertion Loss Measurement. The multimeter measures insertion loss over a measurement range of 0 to 50 dB at a frequency range determined by the bandwidth of the microwave unit being used. The multimeter zeros itself before each measurement, then leads the operator through any required calibration process by displaying instructions on the LCD readout. Insertion loss can be measured at a single frequency point or in auto step. Frequency end points for "AUTO STEP" are operator selectable. In auto step, insertion loss may be presented in any one of three modes: first, display minimum and maximum data only, second, display data at every measurement point and then continue to the next point and third, display data at each point and then wait for the operator to continue. When searching for discontinuities by measuring peak values of insertion loss, the multimeter, in the sweep mode, has a distinct advantage over digital systems which must be stepped at given increments, possibly missing the presence of a discontinuity. The flexibility of the multimeter allows many variations of insertion loss measurement, which can be applied to such tasks as determining insertion loss and on-off ratio measurements of PIN switches, measuring balance and insertion loss of a power divider, or gain or reverse isolation of an amplifier. See paragraph 2.13.5 in Section II of this manual for details of these applications.

1.2.3. Gain Measurement. The multimeter measures gain over a measurement range of 0 to 63 dB at a frequency range determined by the bandwidth of the microwave unit being used. The dynamic range is extended to 63 dB without degrading any other specification by using external attenuators. After zeroing itself, the multimeter leads the operator through any required calibration process, (by displaying instructions on the LCD readout) before making measurements. Frequency measuring points

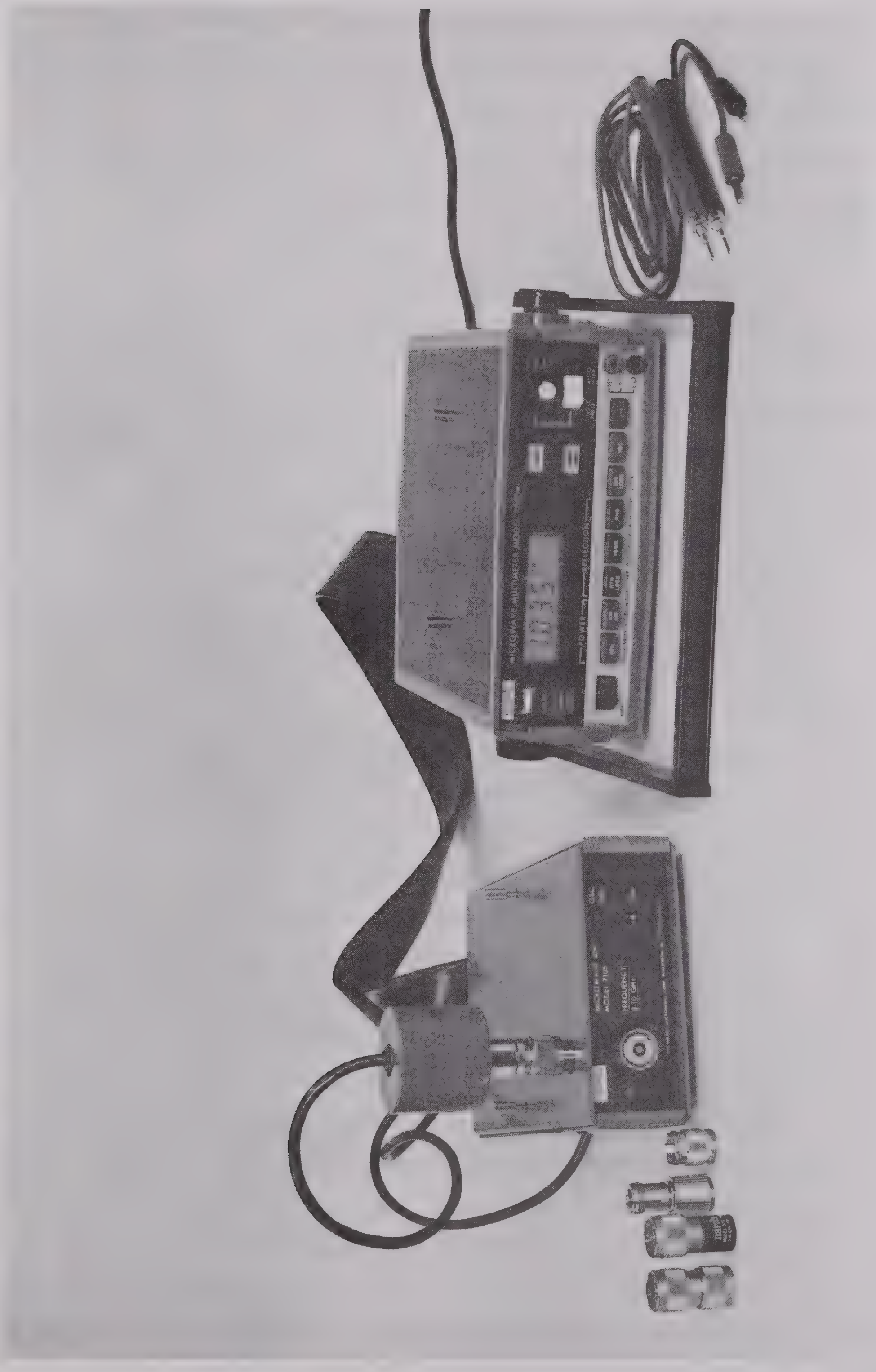


Figure 1-1. Microwave Multimeter and Associated Equipment

are operator selectable. Gain can be measured at a single frequency point or in auto step. In "AUTO STEP", gain may be presented in any one of three modes: first, display min and max data only, second, display data at each point and then continue to the next point and third, display data at each point and then wait for the operator to continue.

1.2.4. Reflection Measurement. The multimeter measures reflection over a measurement range determined by the microwave unit being used (typically, 0 to 35 dB return loss). Frequency range covers 10 MHz - 18 GHz determined by the bandwidth of the microwave unit being used. After zeroing itself, the multimeter leads the operator through any required calibration process (by displaying instructions on the LCD readout) before measurements are made. Frequency measuring points are operator selectable. Reflection can be measured at a single frequency point or in auto step. In "AUTO STEP," reflection measurements may be presented in any one of three modes: first, display minimum and maximum data only, second, display data at each point and then continue to the next point and third, display data at each point and then wait for the operator to continue. Reflection values may be displayed in any one of three modes: Return loss, VSWR or RHO. The operator is free to change from among these three modes without recalibrating. Refer to Figure 1-1 and note the buttons enclosed within the "REFLECTION" bracket.

1.2.5. Signal Generator. The multimeter can function as a manually tuned cw signal generator or as a sweep signal generator. In either mode, the multimeter can function as a signal generator in conjunction with either microwave units that have an internal source, or microwave units that require an external source. The multimeter may be switched between any other mode such as insertion loss or VSWR and either signal generator for the manually tuned cw function, or sweep generator for the sweep function, without requiring recalibration. When operating as a manually tuned cw signal generator, the full frequency band of the microwave unit is available despite any frequency end points that might have been selected, and the tuning voltage available is 0V to 10V. With the multimeter in sweep signal generator mode, the microwave unit's internal oscillator is repetitively swept from the lower frequency end point to the upper frequency end point, and the oscilloscope will present eleven bright spots along the detector output trace with one additional bright spot at the end of the trace on the ground reference line. These are frequency markers evenly spaced and are provided for operator reference. These bright spots correspond to the actual points measured during "AUTO STEP."

1.2.6. **Digital Voltmeter.** The multimeter also functions as an autoranging digital voltmeter having a dynamic range of ± 199 Volts, a one megohm input impedance and autopolarity.

1.3. SPECIFICATIONS.

Table 1-1 through 1-7 covers the specifications for the multimeter. Unless otherwise noted, parameters are stated at 23°C.

Table 1-1

Power Meter Specifications

Specification	Description
FREQUENCY:	10 MHz to 18 GHz
POWER LEVEL:	-50 to +13 dBm 10 nW to 20 mW
POWER SENSOR:	Zero Bias Schottky
SENSOR VSWR:	≤ 1.50:1, 0.01 to .05 GHz ≤ 1.20:1, .05 to 4 GHz ≤ 1.4:1, 4 to 18 GHz
MAXIMUM POWER:	200mW Average for one minute 1 Watt Peak 20 Volts AC + DC
INSTRUMENT ACCURACY:	±3% (±0.15 dB)
ZERO:	Set automatically during calibration. The residual zero error is eliminated on every range.
CALIBRATION FACTOR:	Calibration factor is stored in the microwave unit. The frequency of the measurement is entered with the "Tune" control and automatically corrects the measured power.

Table 1-2

Insertion Loss and Gain Measurements

Specification	Description
MEASUREMENT RANGE:	0 to 50 dB 10 MHz to 18 GHz
FREQUENCY RANGE: 10 MHz to 18 GHz	Depends on Microwave Unit Selected (Ref. Table 1-8)
TEST PORT VSWR:	Depends on Microwave Unit 1.1:1 For Most Units, 7100 Series, 1.3:1 For .01-2 GHz Model 7202 1.5:1 For 2-18 GHz Model 7206.
AUTO-RANGING:	System automatically selects optimum range
AUTO-ZEROING:	System zeros itself before each measurement
SELF-CALIBRATING:	Calibration instructions are given to the operator when a calibration is required
MEASUREMENT POINTS:	SINGLE FREQ: One point continuously adjustable. AUTO STEP: 12 or 52: 11 or 51 equally spaced fixed points plus variable single frequency point.*
INSTRUMENT ACCURACY:	±3% (±.15 dB)
DISPLAY MODES:	Three Operator-Selectable Display Modes: 1. Display minimum and maximum data only 2. Display data at each point and then continue to next point 3. Display data at each point and wait for operator control before continuing.

*Operator-selectable End Points

Table 1-3

Reflection Measurements

Specification	Description
DISPLAY MODES:	RETURN LOSS VSWR RHO
MEASUREMENT RANGE:	Depends on Microwave Unit Selected. Example: for Model 7105, 8 - 10 GHz unit Return loss: 0 to 35 dB VSWR: 1.035 to 200:1 RHO: 0.18 to 1.0
FREQUENCY RANGE:	Depends on Microwave Unit Selected (Ref. Table 1-8)
TEST POINT VSWR:	Depends on Microwave Unit Used 1.1:1 For Most Narrow Band Models 1.3:1 For 0.1-2.0 GHz Model 7202 1.5:1 For 2-18 GHz Model 7206
DIRECTIVITY:	Depends on Microwave Unit Used 40 dB For Most Narrow Band Models 40 dB For 10 MHz to 2 GHz Model 7202 35 dB For 2-18 GHz Model 7206
AUTO-RANGING:	System automatically selects optimum range
AUTO-ZEROING:	System zeros itself before each measurement
SELF-CALIBRATING:	Calibration instructions are given to the operator when a calibration is required.
MEASUREMENT POINTS:	SINGLE FREQ: Repetitively makes measurements at one point. Continuously adjustable with "TUNE" control. AUTO STEP: 12 or 52 points: 11 or 51 equally spaced points plus variable single frequency point.*
INSTRUMENT ACCURACY:	±3% (±.15 dB)

*Operator-selectable End Points

Table 1-3 (Cont)

Specification	Description
DISPLAY MODES:	Three Operator-selectable Display Modes: 1. Display minimum and maximum data only 2. Display data at each point and then continue to next point 3. Display data at each point and wait for operator control before continuing

Table 1-4

Signal Generator Specifications

Specification	Description
FREQUENCY RANGE:	10 MHz - 18 GHz depending on Microwave Unit
FREQUENCY ACCURACY:	Typical ±1% depending on Microwave Unit (Ref. Table 1-8)
OUTPUT POWER:	Approximately 1 Milliwatt
MODES:	CW SWEEP
TUNING:	CW MODE: Frequency is controlled by "TUNE" control and is displayed in liquid crystal display. SWEEP MODE: Frequency is swept repetitively across the operator selected in band range of the microwave unit used.
SWEEP OUT:	0 to 10V For horizontal axis on oscilloscope

Table 1-5

Digital Voltmeter Specifications

Specification	Description
DC Range:	±199V
Range Control:	Automatic
Polarity:	Automatic
Resolution:	0-1.99V Range: 2mV 1.99-19.9V Range: 20 mV 19.9-199V Range: 200 mV
Input Impedance:	1MΩ for "Hi" Probe, 300KΩ for Low Probe
Accuracy:	±.5% of full range
Burnout (Either input to ground):	±500V

Table 1-6

Environmental/Physical Specifications

Specification	Description
Temperature:	Operating 0 to 50°C Non-Operating -40 to + 60°C
Humidity:	0% to 95% relative humidity (non-condensing)
Altitude:	Operating 0 - 15,000 Ft. Non-Operating 0 - 25,000 Ft.
Physical Dimensions:	Height: 3 1/2" (including feet) Width: 10" (including handle) Length: 10 5/8" (including "TUNE" control and handle) Weight: 5 lbs 9 oz (less batteries)

Table 1-7

System Power Requirements

Specifications	Description
Model 7000A	
Voltages:	100 VAC $^{+6\%}_{-10\%}$ at 0.1 Amp 120 VAC $^{+6\%}_{-10\%}$ at 0.1 Amp 220 VAC $^{+6\%}_{-10\%}$ at 0.05 Amp 240 VAC $^{+6\%}_{-10\%}$ at 0.05 Amp
Frequency:	47-440 Hz
Model 7000A-01 BATTERY PACK (with Charger)	
Voltages:	115 VAC $^{+10\%}_{-6\%}$ at 0.1 Amp +15.0 to 12.0V for cigarette lighter optional 230 VAC $^{+10\%}_{-6\%}$ at 0.05 Amp
Frequency:	47-440 Hz
Operation (Fully Charged):	6 hours minimum
Charge Time:	16 hours with unit off*
Life Expectancy (Typ.):	1,000 Charge/Discharge cycles

* To obtain the full rated capacity from Nicad batteries, and avoid "memory" or overcharging effects, the preferred method is to "exercise" the batteries. That is, Nicad batteries exhibit best performance if they are charged to 100% (not to exceed 24 hours continuous charge for a completely discharged battery and proportionately less for a partially discharged battery) and then the batteries are used to operate the system until they are nearly discharged before recharging for 16 hours (typical). Though the charger/P.S. supplied with the 7000A-01 is capable of continuous operation of the unit indefinitely from the AC line, independent of the state of the batteries, operation from the batteries rather than the power supply is advisable whenever practical to insure maximum available capacity from the batteries at all times.

1.4. REQUIRED EQUIPMENT.

A complete microwave measurement system must include a Narda series 7100 or 7200 Microwave Unit purchased separately. The 7100 Series microwave unit contains a high directivity coupler or bridge, detector and voltage tuned oscillator. Standard microwave units cover the most popular bands; other bands can be covered by special order. Broadband measurements can be made over a frequency range of 10 MHz to 2.0 GHz with the Narda microwave unit Model 7202 or over a frequency range of 2.0 GHz to 18 GHz with the Model 7206 Microwave Unit. A standard sweeper that covers the microwave unit's frequency range must be used. See Table 1-8 for selection of microwave units.

Table 1-8

Selection of Microwave Units

NARDA MODEL NO.	FREQUENCY RANGE	REMARKS
7102	0.6 - 1.0 GHz	Has self-contained microwave source
7112	1.0 - 1.6 GHz	Has self-contained microwave source
7112-S1	0.9 - 1.3 GHz	Has self-contained microwave source
7123	1.7 - 2.3 GHz	Has self-contained microwave source
7123-S1	2.2 - 2.7 GHz	Has self-contained microwave source
7133	2.1 - 3.5 GHz	Has self-contained microwave source
7113	2.7 - 3.5 GHz	Has self-contained microwave source
7103	3.7 - 4.2 GHz	Has self-contained microwave source
7134	4.0 - 4.5 GHz	Has self-contained microwave source
7124	5.3 - 6.0 GHz	Has self-contained microwave source
7114	5.9 - 6.5 GHz	Has self-contained microwave source
7144	6.5 - 7.2 GHz	Has self-contained microwave source
7104	7.2 - 8.4 GHz	Has self-contained microwave source
7105	8.0 - 10.0 GHz	Has self-contained microwave source
7105-S1	9.5 - 10.6 GHz	Has self-contained microwave source
7115	10.5 - 12.7 GHz	Has self-contained microwave source
7202	10 MHz - 2.0 GHz	Used with an external microwave source.
7206	2.0 - 18.0 GHz	Used with an external microwave source.

Note: Contact factory for the latest microwave unit availability.

1.5. ACCESSORIES SUPPLIED.

Table 1-9 lists the accessories supplied with Model 7000A. Table 1-10 lists the accessories supplied with Model 7000A-01.

Table 1-9

Accessories Supplied with Model 7000A

ACCESSORY	NARDA PART NUMBER
Voltmeter Test Lead Kit	81813000
37 Conductor Cable Assembly	319067
Power Cord	89603005

Table 1-10

Accessories Supplied with Model 7000A-01

ACCESSORIES	NARDA PART NUMBER
Voltmeter Test Lead Kit	81813000
37 Conductor Cable Assembly	319067
115/230 V Charger	84047000
Shoulder Strap Kit	318943
12 Volt Lighter Charger	319336

1.6. OPTIONS.

Accessory options are listed in Table 1-11 and selectively discussed in paragraphs 1.6.1 through 1.6.2.2. Equipment options are listed in Table 1-12 and discussed in paragraphs 1.6.3 and 1.6.4.

1.6.1. Carrying Case. A carrying case, Narda part number 318941 is available to transport the multimeter and its associated microwave unit, adapters, RF cables, voltmeter probes and AC adapter/charger.

1.6.2. Rack Mounting. Referring to Figure 1-2, there are two separate rack mounting options. Both are compatible with EIA standard nineteen inch (48.3 cm) racks. They are:

1.6.2.1. Rack Mounting Kit. This option is used to rack mount the multimeter. It is Narda part number 106281.

1.6.2.2. Rack Mounting Storage Drawer. This option provides a convenient place to store microwave units. It is Narda part number 106282.

1.6.3. Battery. An optional battery supply is available for use with the multimeter. To specify this option, simply add the suffix "-01" to the equipment model number. In addition to the battery and power supply, an AC adapter is supplied for recharging the battery from a 120 or 240 VAC power source. Also supplied is a cigarette lighter adapter for operating the multimeter from a +12 to +15V negative ground automobile cigarette lighter.

Table 1-11

Accessory Options*

DESCRIPTION	NUMBER
Carrying Case for 7000A and one Microwave Unit with associated equipment	318941
Printer - 110VAC	7500
Printer - 230VAC	7501
Rack Mounting Kit	106281
Rack Mounting Storage Drawer	106282
Detector, Type N	503
Type "N" Short/Open male	231-416
Type "N" Short/Open female	231-412
7 mm Short/Open	5231
3 mm Short/Open male	4231-416
3 mm Short/Open female	4231-412
Calibrated Attenuator Set 7 MM	5120A
Calibrated Attenuator Set, type "N"	120A
Attenuator, Type "N", 3 dB:	779-3
Attenuator, Type "N", 6 dB:	779-6
Attenuator, Type "N", 10 dB:	779-10
Attenuator, Type "N", 20 dB:	779-20
Attenuator, Type "N", 30 dB"	779-30
Termination (Type N):	379BNM
Termination (7 mm):	5379
Termination (3 mm):	4379 BM

*See Table 1-7, Page 1-12 of the Microwave Unit's manual for optional adapter kits (Table 1-9 for models 7202 and 7206)

Table 1-12

Equipment Options

DESCRIPTION	NUMBER
Battery Operation	-01
IEEE 488 Bus (Remote) Operation	-02

1.6.4. Remote Operation. The multimeter can be remotely controlled either by the IEEE 488 standard bus or by the IEC-625-1 (Europe) interface. All units are supplied with the bus connector. The bus option includes the addition of a switch, decoder, bus controller and interface circuits. See paragraph 2.18 Remote Operation in Section II of this manual for additional reference. To specify remote operation option add the suffix "-02" to the equipment model number (i.e., 7000A-02 or 7000A-01-02).

1.7. UNPACKING AND RESHIPMENT.

The following instructions should be carefully observed to avoid damage to the multimeter caused by transportation and handling.

1.7.1. Unpacking. Unpacking of the Microwave Multimeter should be done with extreme care. The equipment is normally shipped in a double cardboard carton and lined with foam filler material for protection. Before opening, visually inspect the carton to ensure that no damage has occurred during transit. If damaged, notify the shipping agent immediately. If there is no evidence of damage, carefully unpack and remove the equipment.

NOTE

It is suggested that the shipping container and packing material be stored for possible reshipment of the unit.

1.7.2. Reshipment. When reshipping the unit, use the original packing material and shipping container, or a good commercial grade high density filler material approximately four inches (10 cm) thick and double high-burst cardboard carton.

1.7.3. Packing. When packing the unit for reshipment, proceed as follows:

1.7.3.1. Cover the bottom of the carton with filler material;

1.7.3.2. Place the unit into the carton;

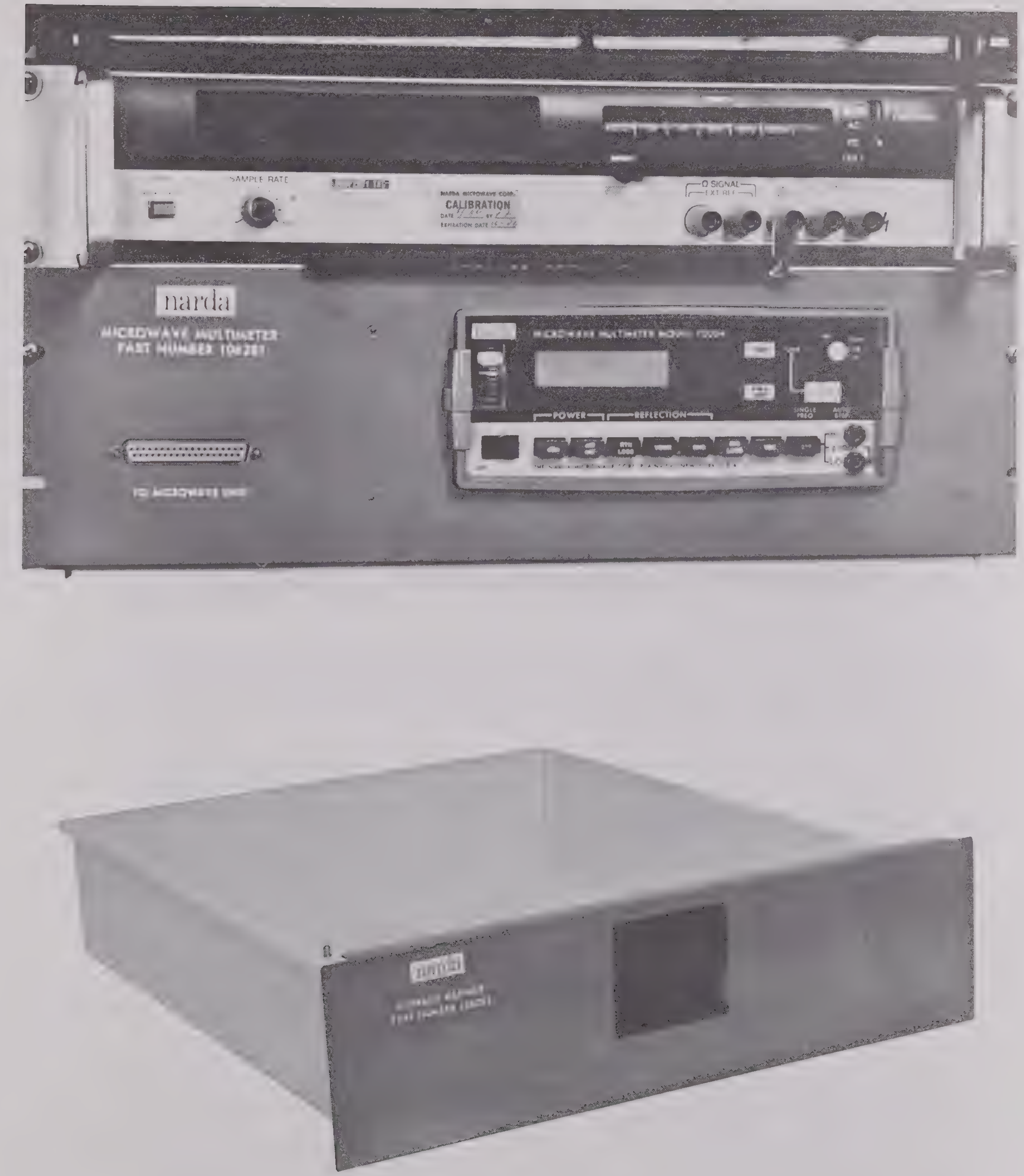

SAMPLE RATE
NARDA MICROWAVE CORP.
CALIBRATION
DATE
BY
EXPIRATION DATE
Ω SIGNAL
EXT REF
narda
MICROWAVE MULTIMETER
PART NUMBER 10K281
TO MICROWAVE UNIT
MICROWAVE MULTIMETER MODEL 7000A
POWER
REFLECTION
SINGLE FREQ
narda

Figure 1-2. Rack Mounting Options

WARRANTY

The Narda Microwave Corporation warrants each product of its manufacture to be free from any defect in material and workmanship for a period of one year after delivery to, and return by, the original purchaser. All warranty returns, however, must first be authorized by factory office representative.

The limit of liability under this warranty shall be to repair or replace any product, or part thereof, which proves to be defective after inspection by Narda. This warranty shall not apply to any Narda product that has been disassembled, modified, physically or electrically damaged or any product that has been subjected to conditions exceeding the applicable specifications or ratings.

The Narda Microwave Corporation shall not be liable for any direct or consequential injury, loss or damage incurred through the use, or the inability to use, any Narda product.

The Narda Microwave Corporation reserves the right to make design changes to any Narda product without incurring any obligation to make the same changes to previously purchased units.

This warranty is the full extent of obligation and liability assumed by The Narda Microwave Corporation with respect to any and all Narda products. Narda neither makes, nor authorizes any person to make, any other guarantee or warranty concerning Narda products.

SECTION II

MICROWAVE MULTIMETER OPERATION
NARDA Model 7000A and 7000A-01

2.1. INTRODUCTION.

This section provides a general description of controls, indicators, pre-operational checkout and operating instructions for Narda's Model 7000A Microwave Multimeter.

2.2. INITIAL INSPECTION.

The Model 7000A was tested and inspected at the factory before shipment. Initially inspect the unit according to instructions in Section I, paragraph 1.7.1 of this manual. If any equipment is damaged, notify The Narda Microwave Corporation and the carrier immediately.

2.3 PREPARATION FOR USE.

Before connecting the multimeter to a power source, be sure that power and voltage has been selected according to the following instructions under paragraphs 2.4. and 2.5.

2.4. POWER REQUIREMENTS.

2.4.1. Model 7000A. Model 7000A Microwave Multimeter requires a power source of 100, 120, 220, or 240 volts AC, +6%, -10%, 47 to 440 Hz single phase. Power consumption is approximately 12 watts.

2.4.2. Model 7000A-01. Model 7000A-01 Microwave Multimeter requires a power source of 115 or 230 VAC +10%, -6%, 47 to 440 Hz single phase for the AC Charger/ Adapter or +12 to +15V through the cigarette lighter adapter.

2.5. LINE VOLTAGE SELECTION.

2.5.1. Model 7000A. To select the proper line voltage for Model 7000A, go to the rear panel and proceed as follows:

2.5.1.1. Remove power cord.

2.5.1.2. Slide cover door open, rotate fuse-pull handle to the left, and remove the fuse.

2.5.1.3. Select line voltage desired by removing PC board using a needle nose pliers, and replacing it so that the desired voltage is visible on the top left side. Push board firmly into module slot.

2.5.1.4. Rotate fuse-pull handle to the right and insert correct fuse per instructions printed on the rear panel.

2.5.1.5. Slide cover door to the right so that line cord socket is accessible.

2.5.1.6. Reconnect the power cord to the rear panel. Then plug into an appropriate AC power source.

WARNING

> To ensure against electrical shock, Model 7000A is equipped with three wire power line cords. Do not bypass the protective ground when connecting the instrument to a power source, because this will defeat the safety feature.

2.5.2. Model 7000-01. To select the proper line voltage for Model 7000A-01, proceed as follows:

2.5.2.1. The AC adapter has a voltage select slide switch on the front surface.

2.5.2.2. Set this switch to the proper line voltage position by sliding the switch to the right to read 230V AC or to the left to read 115V AC.

2.5.2.3. Plug the AC adapter lead to "CHARGER IN" port, located on the rear panel of 7000A-01.

2.5.2.4. Plug AC adapter into an AC power source.

WARNING

> To prevent electrical shock, connect the chassis ground, located on rear panel, to a good earth ground.

2.6. RACK MOUNTING OPTION INSTALLATION.

To install the rack mounting kit, follow the procedure under paragraph 2.6.1. To assemble the rack mounted storage drawer, follow the procedure under paragraph 2.6.2. Using the rack mounted storage drawer is explained in paragraph 2.6.3. If additional reference is desired, see Figure 1-2 and paragraph 1.6.2 in Section I of this manual.

2.6.1. Rack Mounting Kit. To install rack mounting kit Narda part number 106281, proceed as follows:

2.6.1.1. Pry the flat circular cap off each side of the multimeter's handle and remove the oval phillips head self tap screw, button and spring, from beneath the cap.

2.6.1.2. With all handle connecting hardware removed, spread the handle slightly to disengage it from the sides of the multimeter. Remove handle.

2.6.1.3. Install the multimeter in the rack mounting chassis by using one L shaped bracket on each side of the multimeter.

2.6.1.3.1. To mount one L shaped bracketed to each side of the multimeter, attach each bracket to the multimeter boss, using #4-40 x 1/2" long self-tap screws and flat washers in two places.

2.6.1.3.2. Attach each L shaped bracket to the rack mounting chassis, using 6-32 x 7/16" long pan head screws, flat washers, lockwashers and nuts in two places.

2.6.1.4. Install the multimeter through the front panel opening and secure it with a triangular bracket on each side.

2.6.1.4.1. Install each triangular bracket over #10-32 studs in the rack mounting front panel, using flat washers, lockwashers, and #10-32 nuts in four places.

2.6.1.5. Install electrical connector (female side, without strain relief clamp) in front panel opening, using screw lock assemblies.

2.6.1.6. Attach other end of connector (male side, with strain relief clamp) to rear of multimeter connector, marked "TO MICROWAVE UNIT."

2.6.2. Rack Mounted Storage Drawer. To assemble rack mounted storage drawer Narda part number 106282, proceed as follows:

2.6.2.1. Attach slides to drawers.

2.6.2.2. Using the Rack Mounted Storage Drawer. Microwave units are attached to the standoffs, using existing spring loaded screws located on the microwave unit. The power sensor assembly may be mounted to the front of the microwave unit by using the connector, to prevent damage.

2.7. PANEL FEATURES.

The front and rear panel features of the Model 7000A and 7000A-01 are illustrated in Figures 2-1, 2-2, and 2-3, and described in Tables 2-1, 2-2, and 2-3.

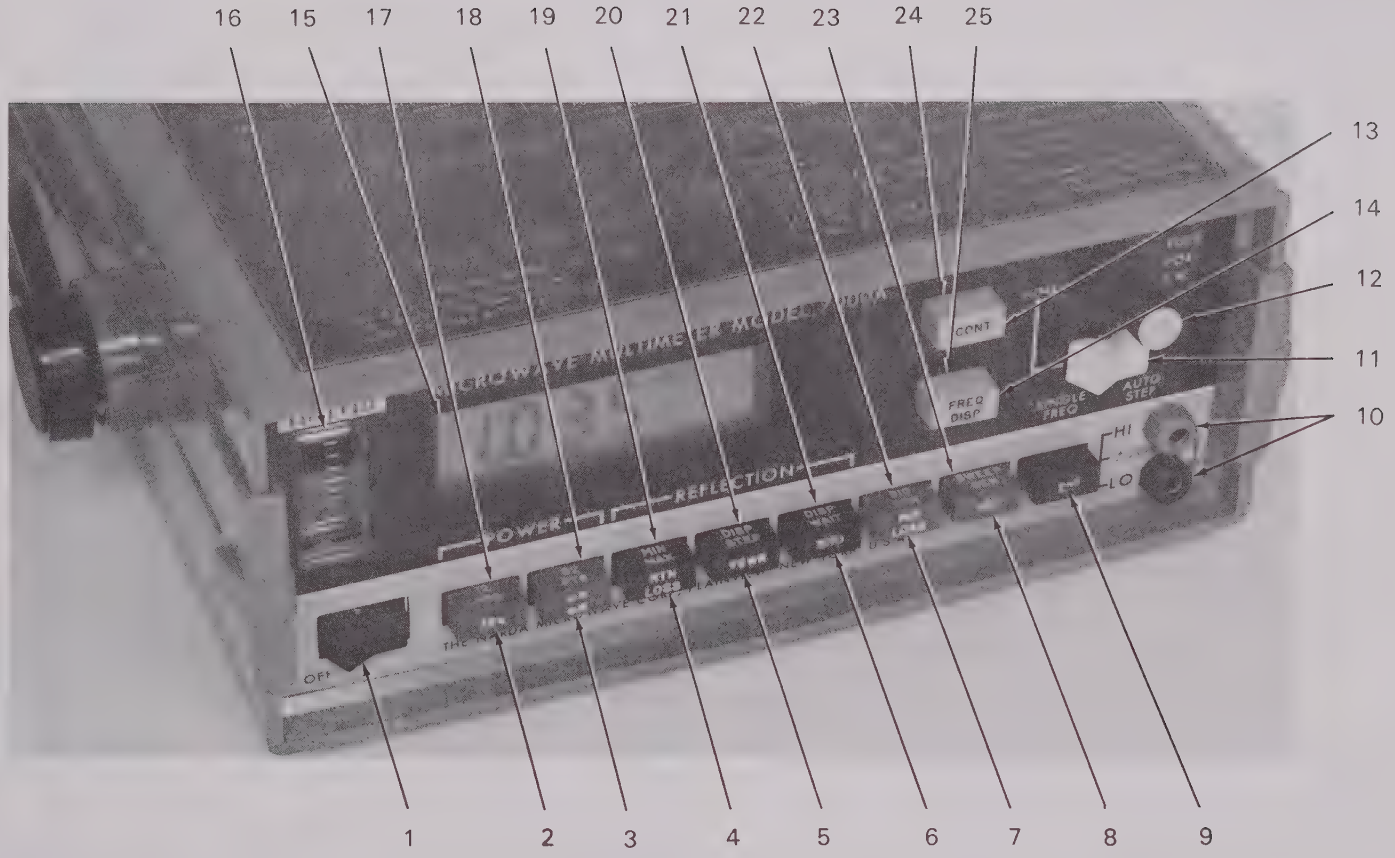

16
15
17
18
19
20
21
22
23
24
25
13
14
12
11
10
1
2
3
4
5
6
7
8
9
POWER
REFLECTION
CONT
FREQ DISP
SINGLE FREQ
AUTO STEP
HI
LO
OFF

Figure 2-1. Model 7000A and Model 70001-01 Microwave Multimeter, Front Panel Controls and Indicators

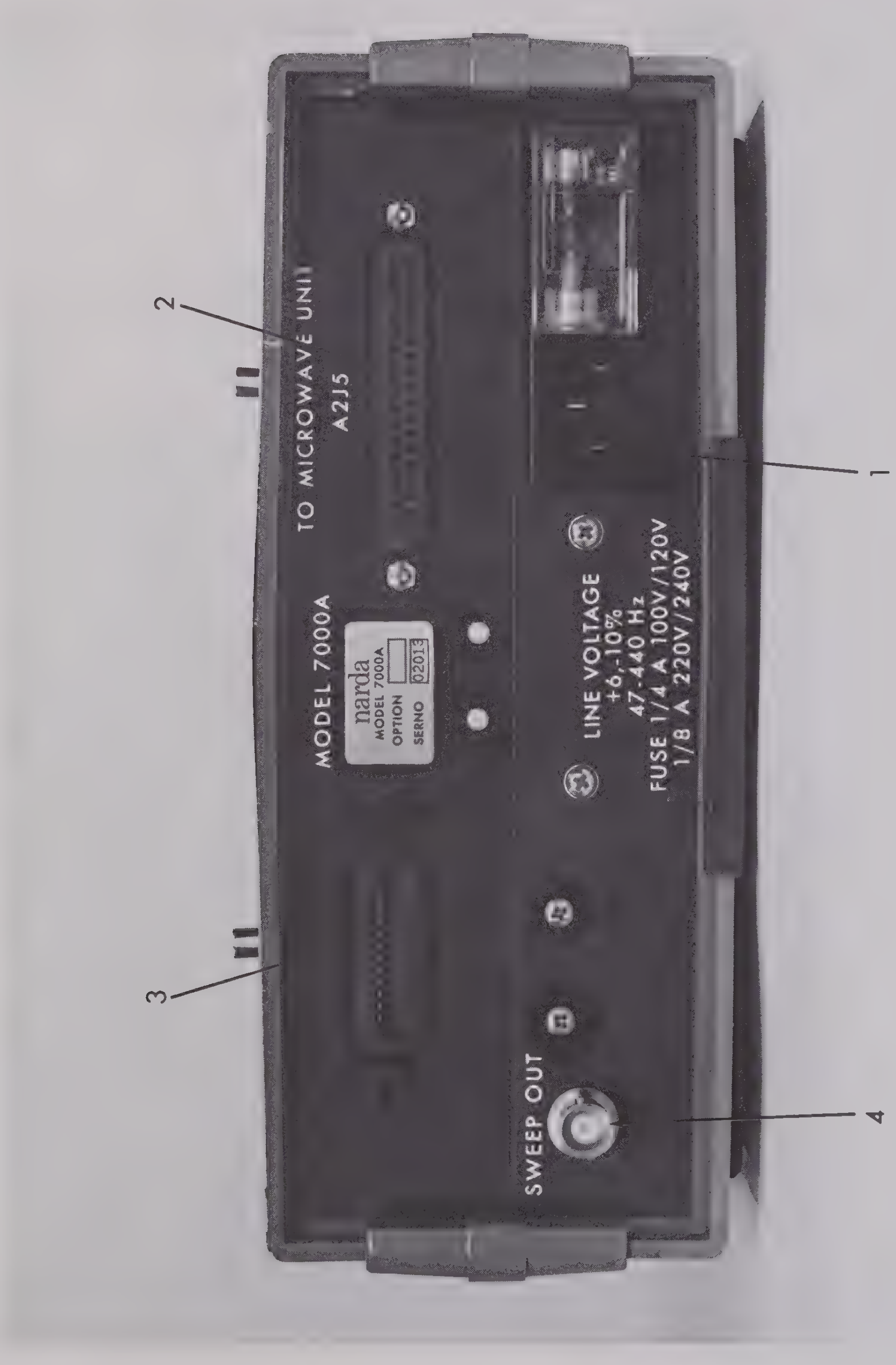

2
TO MICROWAVE UNIT
A2J5
1
MODEL 7000A
narda
MODEL 7000A
OPTION
SERNO 02013
LINE VOLTAGE
+6,-10%
47-440 Hz
FUSE 1/4 A 100V/120V
1/8 A 220V/240V
3
SWEEP OUT
4

Figure 2-2. Model 7000A Microwave Multimeter, Rear Panel Controls and Indicators

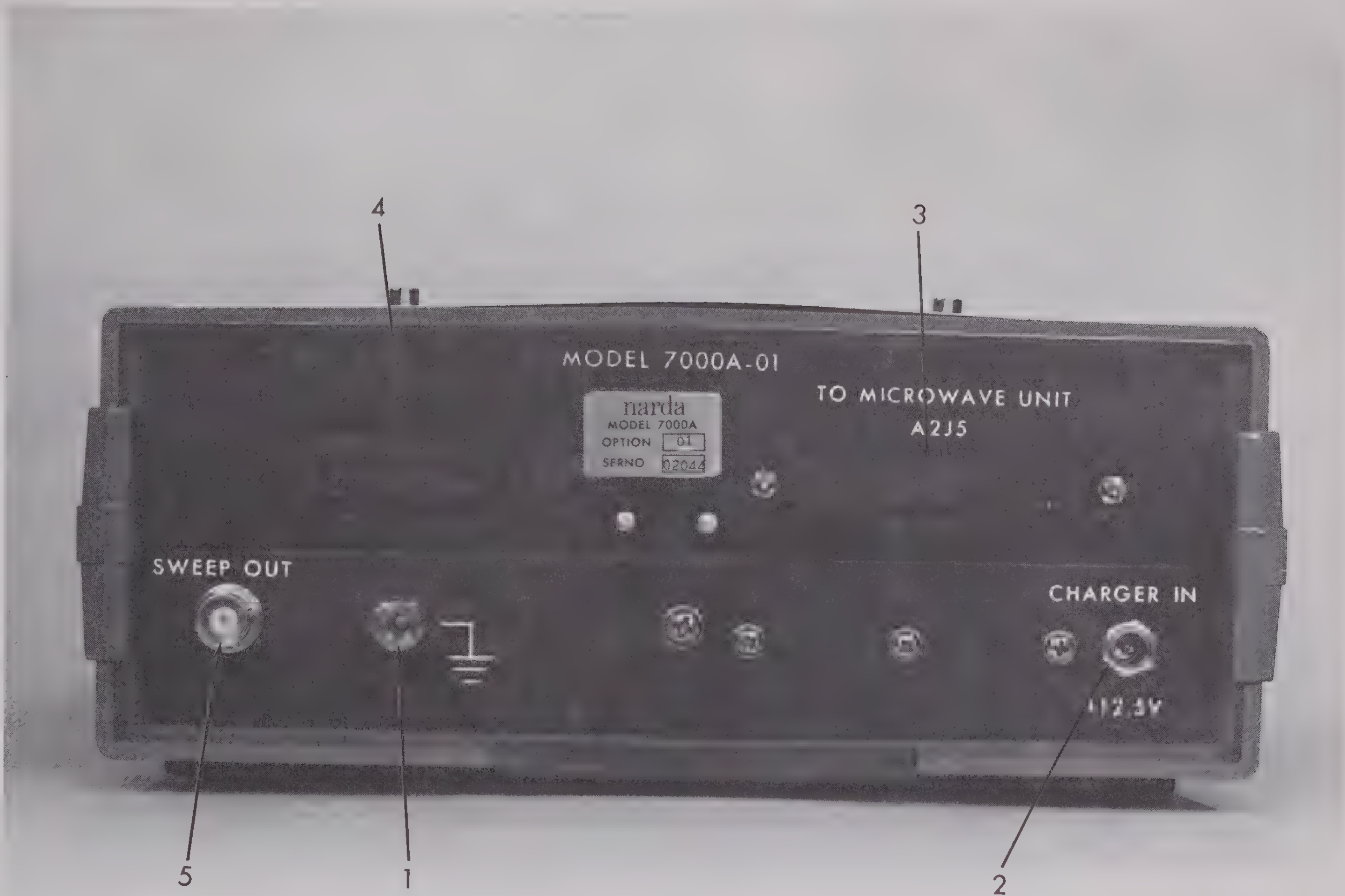

4
3
MODEL 7000A-01
narda
MODEL 7000A
OPTION 01
SERNO 02044
TO MICROWAVE UNIT
A2J5
SWEEP OUT
CHARGER IN
+12.3V
5
1
2

Figure 2-3. Model 7000A-01 Microwave Multimeter Rear Panel Controls and Indicators

Table 2-1

Model 7000A Microwave Multimeter Front Panel Controls and Indicators

FIGURE 2-1 INDEX NO.	CONTROL	FUNCTION
1	Power Switch	Controls primary power to instrument
	PRIMARY CONTROLS (Buttons Front Surfaces)	
2	Power -dBm	Selects power meter mode of operation and displays results in dBm.
3	Power-mW/μW	Selects Power Meter mode of operation and displays results in mW/μW .
4	Reflection-RTN LOSS	Selects reflection mode of operation, and measures and displays the return loss in dB.
5	Reflection-VSWR	Selects reflection mode of operation, and measures and displays voltage standing wave ratio.
6	Reflection-RHO	Selects reflection mode of operation, and measures and displays the reflection coefficient.
7	INS LOSS	Selects insertion loss mode of operation and displays results in db. (Positive numbers indicate loss and negative numbers indicate gain).
8	VDC	Selects Voltmeter mode of operation and displays the voltage across the voltmeter leads.
9	Second Function	Causes controls 2-8, 14 and 15 to take on their secondary function.
10	Voltmeter Inputs HI - LO Jacks	Provides input jacks for Voltmeter probes.
11	SINGLE FREQ/AUTO STEP	Selects either single frequency or auto step mode of operation for reflection and insertion loss measurements.

Table 2-1 (Cont)

FIGURE 2-1 INDEX NO.	CONTROL	FUNCTION
12	TUNE PUSH FOR CW Knob	Selects frequency (rotation) and turns on the RF oscillator (push) in ins. loss and reflection modes.
13	CONT	Steps the calibration and measurement modes for power meter, reflection and insertion loss measurements.
14	FREQ DISP	Causes the measurement frequency to be displayed .
15	LCD Indicator	Displays data and annunciators. Displays are 3 1/2 digital LCD, readable in direct sunlight .
16	Analog Meter Peaking	Provides an analog display of the approximate percentage of full scale for the range of the measurement.
	SECONDARY CONTROLS (Buttons Top Surfaces)	
17	12 Pts	Causes auto-step measurements to be made at 12 points across the band of the microwave unit.
18	52 Pts	Causes auto-step measurements to be made at 52 points across the band of the microwave unit .
19	MIN/MAX	Causes the minimum and maximum values of the measurements across the band to be displayed in auto-step mode.
20	DISP STEP	Causes the value of each measurement to be displayed in auto step mode .

Table 2-1 (Cont)

FIGURE 2-1 INDEX NO.	CONTROL	FUNCTION
21	DISP WAIT	Causes the value of each measurement to remain displayed until CONT is pressed. (Used in auto-step mode.)
22	SIG GEN	Turns on oscillator at predetermined frequency according to TUNE control setting.
23	SWEEP GEN	Causes the oscillator to repetitively sweep across its band.
24	CALIB	Causes the system to recalibrate in the mode selected.
25	ENTER	Enters new End Point frequencies for AUTO-STEP measurements and SWEEP GEN.
26	XY	Initiates the XY plot function.

NOTE

Primary control function is shown on the front surface of each control button. The secondary control function is color coded in yellow and is shown on the top surface of each control button.

Table 2-2

Model 7000A Rear Panel Features

FIGURE 2-2 INDEX NO.	CONNECTOR	FUNCTION
1	AC Power	This unit houses the power line fuse and is used to select the proper line voltage. Refer to Para. 2.5.
2	"TO MICROWAVE UNIT"	Interconnects J5 on the multimeter digital (A2) board with the microwave unit. (See Table 1-8 for microwave unit selection).

Table 2-2 (Cont)

FIGURE 2-2 INDEX NO.	CONNECTOR	FUNCTION
3	"Option-2 GPIB IEEE 488-1978 "REMOVE TOP COVER To CHANGE ADDRESS"	Provides IEEE interface connection to J6 on the multimeter's digital (A2) board, for remote programming input compatible with the IEEE-488 bus standard.
4	SWEEP OUT	Gives horizontal trace to oscilloscope during sweep mode.

Table 2-3

Rear Panel Features Model 7000A-01

FIGURE 2-3 INDEX NO.	CONNECTOR	FUNCTION
1	⏚	Provides terminal to ground 7000A-01.
2	Battery charger input	Input connector for battery charger/ AC adapter.
3	"TO MICROWAVE UNIT"	Interconnects J5 on the multimeter's digital (A2) board with the microwave unit. (See Table 1-8 for microwave unit selection).
4	"OPTION-02 GP1B IEEE 488-1978 REMOVE TOP COVER TO CHANGE ADDRESS"	Provides IEEE interface connection to J6 on the multimeter's digital (A2) board, for remote programming input compatible with the IEEE-488 bus standard.
5	SWEEP OUT	Gives horizontal trace to oscilloscope during sweep mode.

2.8. INTERCONNECT AND TURN-ON PROCEDURE.

If using Model 7000A refer to the block diagram in Figure 2-4. If using Model 7000A-01 refer to the block diagram in Figure 2-5. The following procedures apply to both units. If the microwave unit being used requires an external power source, refer to Figure 2-6

CAUTION

Do not use excessive force when mating connectors on the microwave unit. Cross threading, over torquing or other damage to connectors may degrade the accuracy of the microwave multimeter.

2.8.1. Select the proper line voltage. (Refer to paragraph 2.5)

2.8.2. Connect the 37 conductor cable assembly (Narda part number 319067) between "TO MICROWAVE UNIT", located on the rear panel of the multimeter and the 37 pin receptacle marked "TO MODEL 7000A, located on the rear panel of the microwave unit.

2.8.3 Make sure that the system is connected to an appropriate AC power source.

2.8.4. Set power switch to "ON" position. Over a period of approximately five seconds the LCD readout will first display all segments illuminated as shown in Figure 2-7, followed by a brief display of the maximum and minimum rated frequency points of the microwave unit being used*. During this time, the instrument is performing an internal self test of the microprocessor, internal memories and program integrity. After these internal tests have been completed, the LCD readout will indicate that the system is in the "VOLTS" mode. At this point the multimeter is ready for use. If the multimeter does not turn on, refer to Section IV of this manual.

*When using a 7000A-02 with serial number >4000 the LCD will momentarily display the bus address of the unit after the maximum rated frequency. An address >32 indicates the unit is in "talk-only" mode. See Para. 2.18 for discussion of remote operation.

NOTE

For units equipped with GPIB (option -02) the "REM" annunciator will be off. For units without the GPIB option, the "REM" annunciator could be either on or off at this point. If the "REM" annunciator is on, pressing any front panel pushbutton will clear it.

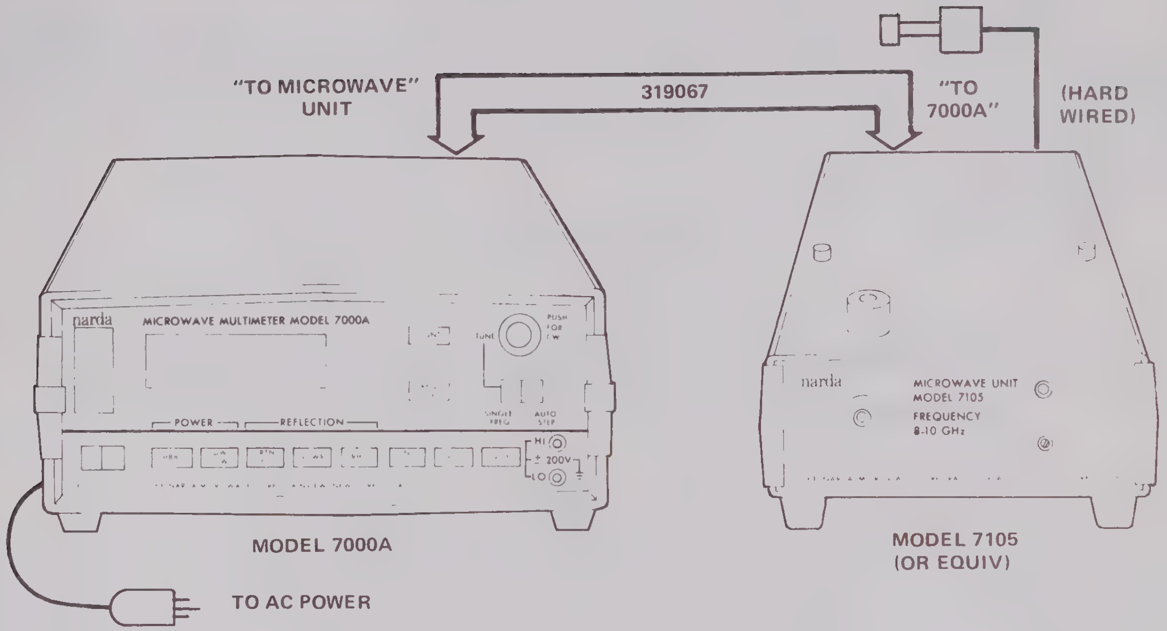

"TO MICROWAVE" UNIT
319067
"TO 7000A"
(HARD WIRED)
narda
MICROWAVE MULTIMETER MODEL 7000A
TUNE
PUSH FOR CW
POWER
REFLECTION
SINGLE FREQ
AUTO STEP
HI
± 200V
LO
narda
MICROWAVE UNIT MODEL 7105
FREQUENCY 8-10 GHz
MODEL 7000A
TO AC POWER
MODEL 7105 (OR EQUIV)

Figure 2-4. 7000A With 7100 Series Microwave Unit: Interconnecting Block Diagram

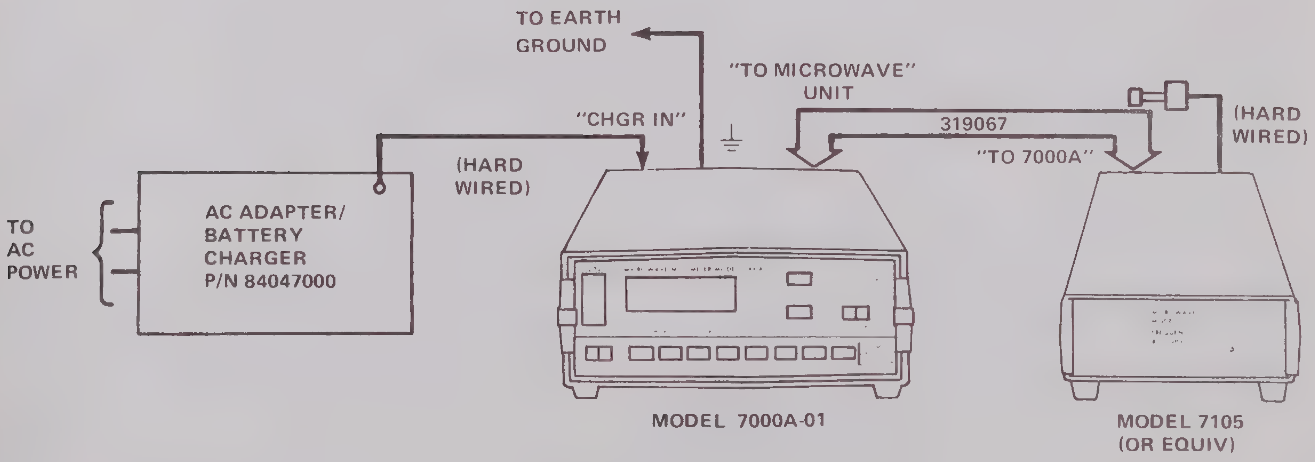

TO EARTH GROUND
"TO MICROWAVE" UNIT
"CHGR IN"
319067
"TO 7000A"
(HARD WIRED)
(HARD WIRED)
TO AC POWER
AC ADAPTER/ BATTERY CHARGER P/N 84047000
MODEL 7000A-01
MODEL 7105 (OR EQUIV)

Figure 2-5. 7000A-01 With 7100 Series Microwave Unit: Interconnecting Block Diagram

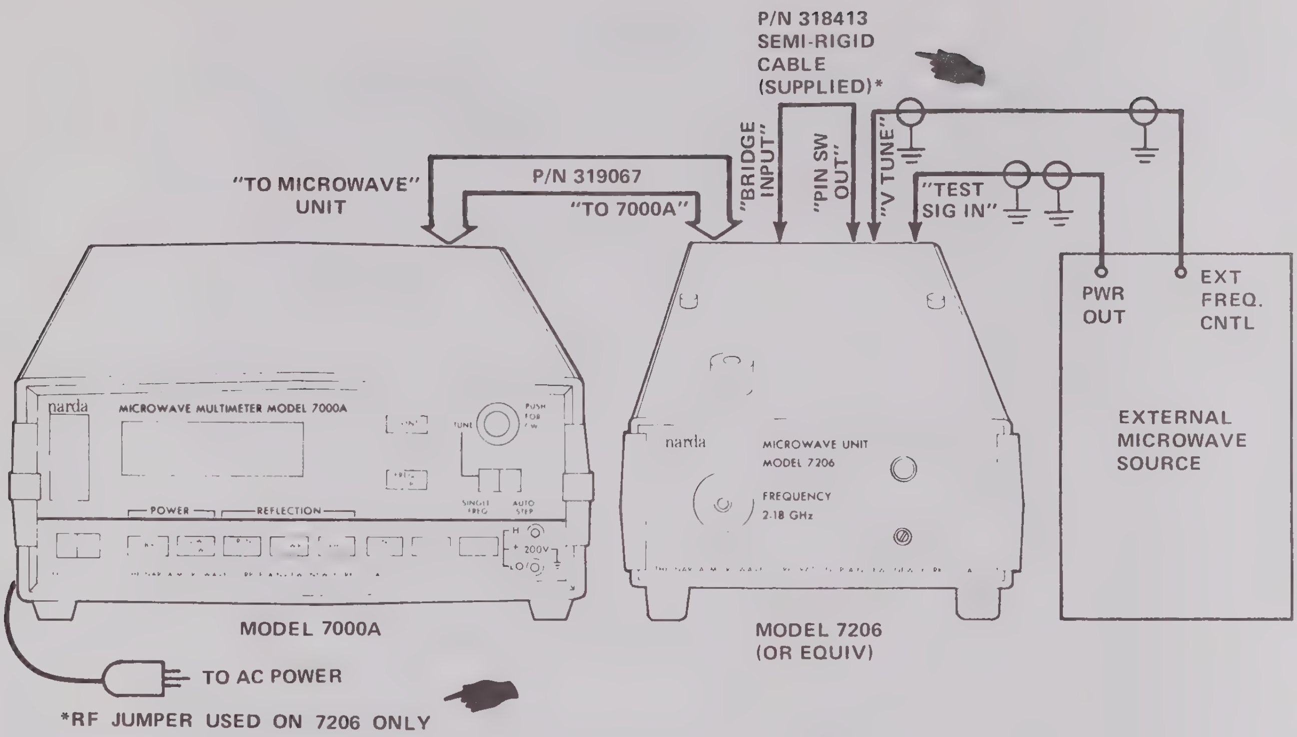

P/N 318413
SEMI-RIGID
CABLE
(SUPPLIED)*
"TO MICROWAVE" UNIT
P/N 319067
"TO 7000A"
"BRIDGE INPUT"
"PIN SW OUT"
"V TUNE"
"TEST SIG IN"
PWR OUT
EXT FREQ. CNTL
EXTERNAL MICROWAVE SOURCE
narda
MICROWAVE MULTIMETER MODEL 7000A
POWER
REFLECTION
TUNE
PUSH FOR F/W
SINGLE FREQ
AUTO STEP
200V
narda
MICROWAVE UNIT MODEL 7206
FREQUENCY 2-18 GHz
MODEL 7000A
MODEL 7206 (OR EQUIV)
TO AC POWER
*RF JUMPER USED ON 7206 ONLY

Figure 2-6. 7000A With 7200 Series Microwave Unit and External Source: Interconnecting Block Diagram - See also the Microwave Unit's Manual Section II.

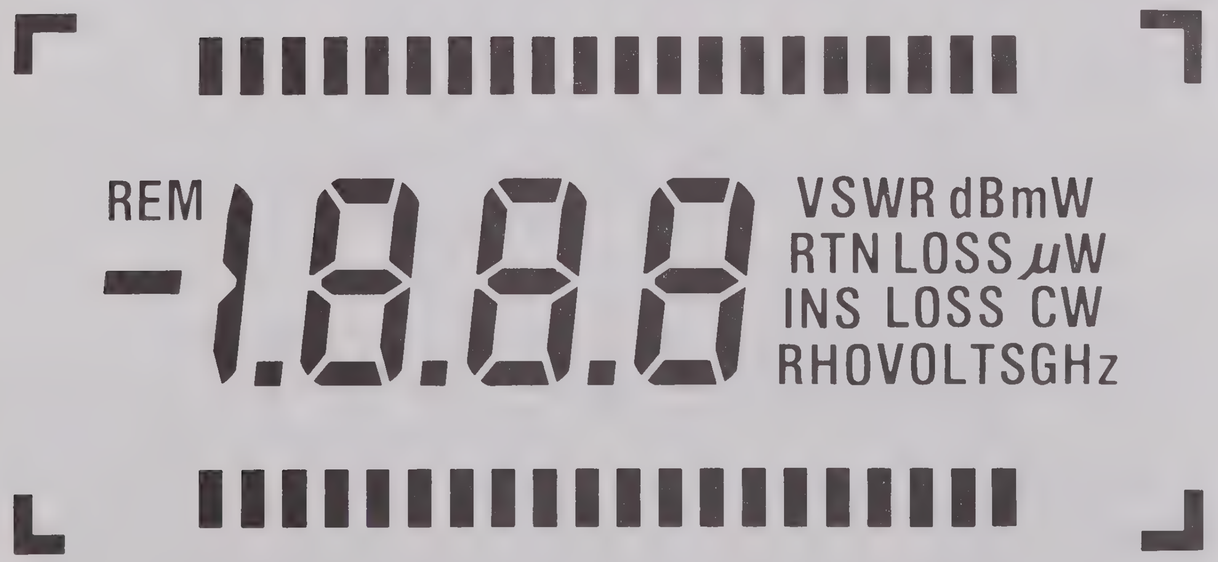

REM
-1.8.8.8
VSWR dBmW
RTN LOSS µW
INS LOSS CW
RHO VOLTS GHz

Figure 2-7. 7000A LCD Readout with All Segments Illuminated

Table 2-4

LCD Annunciators

Display	Meaning
dB RTN LOSS	Return Loss in decibels
VSWR	Voltage Standing Wave Ratio
RHO	Reflection Coefficient
dB INS LOSS	Insertion Loss in decibels
VOLTS	DC Voltage
mW	Power in milliwatts
μW	Power in microwatts
dBm	Power in decibels/milliwatt
GHz	Gigahertz a measurement of frequency
REM	Remote (GPIB) Operation

Table 2-5

Display Abbreviations

Display	Meaning
SH	: Connect short
OP	: Connect open
load	: Connect 50 ohm load
dEt	: Connect detector
dut	: Connect device under test
ur	: Under-range
or	: Over-range
to	: To
rF	: Disconnect Detector from source of power
oFF	
2nd	: 2nd has been depressed

NOTE

> If a 7200 series microwave unit is being used and the multimeter is operated in the SIG GEN, SWEEP GEN FREQ DISP modes, the LCD readout will display a tuning voltage instead of the maximum and minimum rated frequency of the microwave unit.

2.9. PREOPERATIONAL CHECKOUT.

Preoperational checkout should be performed when the unit is first received or whenever verification of proper operation of the multimeter is required. The procedures given here are not the same as those used in normal operations. Refer to paragraph 2.10 for general operating instructions.

NOTE

> Review Interconnect and Turn-on Procedures (paragraph 2.8) before running a preoperational checkout.

2.9.1. To perform preoperational checkout procedures, power must be applied to the Microwave Multimeter. If the LCD readout does not illuminate when power is applied, check the unit as follows:

2.9.1.1. Ensure that unit is connected to a functional power source. If necessary, reconnect to new source.

2.9.1.2. Ensure correct line voltage has been selected as specified in paragraph 2.5. If necessary, reposition printed circuit board.

2.9.1.3. Ensure rear panel fuse is operational. If necessary, replace fuse.

2.9.1.4. Model 7000A-01 (Battery Pack Option), has the fuse located internally. Because the top cover must be removed to check it, refer to paragraph 4.2 in Section IV , Maintenance, before proceeding.

2.9.1.4. Using the ON/OFF Switch, remove and reapply power to reset the microprocessor.

2.9.1.5. If unit remains inoperative, refer to Section IV, Maintenance.

NOTE

Restarting an operational check only requires going back to the first step of that operational check. It is not necessary to restart with the initial turn-on procedure.

2.9.2 Power Meter Preoperational Check. Upon successful completion of all steps listed under 2.9.1 proceed as follows to verify proper function of the multimeter's power meter section:

2.9.2.1. Press dBm .

2.9.2.2. Press 2nd and CALIB . LCD should read "rF OFF."

2.9.2.3. Disconnect the detector from any source of power.

2.9.2.4 Press µW mW . The multimeter should zero in all ranges.

NOTE

The needle of the peaking meter will oscillate during this operation.

2.9.2.5. After the multimeter has zeroed in all ranges, the LCD readout should display "dut,"

2.9.2.6. Press µW mW . The LCD readout should now display "ur."

2.9.2.7. The multimeter will continue to make power measurements. This will be indicated by the movement of the peaking meter needle.

NOTE

With no RF power applied to the detector, as the multimeter warms up the LCD readout may drift and display 0.005 "uW" or "ur." Either is a normal indication.

2.9.2.8. To rezero the multimeter, repeat steps 2.9.2.2 through 2.9.2.5.

2.9.3. Insertion Loss Preoperational Check. To verify proper operation of the multimeter's insertion loss measurement capability, proceed as follows:

2.9.3.1. Press the white rocker switch to "SINGLE FREQUENCY" position.

2.9.3.2. Press INS LOSS , 2nd then CALIB buttons. LCD readout should display "det to J1".

2.9.3.3. Connect detector to J1 on the microwave unit.

2.9.3.4. Press CONT . LCD readout should display "load to J2."

2.9.3.5. Connect the 50 ohm load supplied with the microwave unit to J2 on the microwave unit.

2.9.3.6. Press CONT . The multimeter will now zero on each range automatically and calibrate at 52 points across the microwave unit's frequency range.

NOTE

> During this step the needle of the peaking meter located on the multimeter's front panel should be oscillating, and the "OSC ON" lamp of the microwave unit should be flashing.

2.9.3.7. When the LCD readout displays "dut", calibration, as described in 2.9.3.6, is completed.

2.9.3.8. Press CONT . The LCD readout should now display single frequency measurements.

NOTE

> During this step the needle of the peaking meter located on the multimeter's front panel should be oscillating and the "OSC ON" lamp of the microwave unit should be flashing.

2.9.3.9. When the LCD readout displays ".000dB INS LOSS" (or a value within ±.05 dB) it means that measurements described in 2.9.3.8 are now completed.

2.9.3.10. With the "RF ON" lamp of the microwave unit lit, press and hold the PUSH FOR CW control knob, located on the front panel of the multimeter. The peaking meter needle should hold a steady state reading so long as the knob remains held in by the operator. At the same time, the LCD readout should display the last indicated value.

2.9.3.11. Press FREQ DISP . The LCD readout should now display the frequency of the RF measurements in GHz.

NOTE

> When using a microwave unit which requires an external signal source (7200 series), the LCD readout will display a voltage of some value from 0V DC to 10V DC corresponding to the percentage of the band that is being used.

2.9.4. Reflection Preoperational Check. To verify proper function of the multimeter's reflection measurement capability proceed as follows:

2.9.4.1. Press the white rocker switch to "SINGLE FREQUENCY" position.

2.9.4.2. Press RTN LOSS then 2nd and CALIB . LCD readout should display "det to J2."

2.9.4.3. Connect detector to J2 on the microwave unit.

2.9.4.4. Press CONT . LCD readout will display "SH to J1."

2.9.4.5. Connect RF short (supplied) to J1 on the microwave unit.

2.9.4.6. Press CONT . The system will zero on all ranges and will calibrate at 52 points across the band of the microwave unit.

NOTE

> During this step the needle of the peaking meter located on the multimeter's front panel should be oscillating, and the "OSC ON" lamp of the microwave unit should be flashing.

2.9.4.7. When the LCD readout displays "op to J1," calibration, with referenced short is completed.

2.9.4.8. At J1 on the microwave unit, remove the RF short and connect the RF open. (The open is the other end of the short.)

2.9.4.9. Press CONT. The system will rezero and will recalibrate automatically across the same 52 points.

2.9.4.10. When the LCD readout displays "dut," calibration is complete and the system is ready to make measurements.

2.9.4.11. Remove the RF open from J1 on the microwave unit and replace it with a 50 ohm termination (also supplied).

2.9.4.12. Press CONT. The LCD readout should now display (some value greater than) "14 dB RTN LOSS."

2.9.4.13. Press VSWR. The LCD readout should now display (some value less than) "1.5 VSWR."

2.9.4.14. Press RHO. The LCD readout should now display (some value less than) "0.2 RHO."

2.9.5. Signal Generator Preoperational Check. To verify proper function of the multimeter's signal generator capability, proceed as follows:

2.9.5.1. Press 2nd and SIG GEN.

2.9.5.2. Rotate TUNE control knob fully counterclockwise. The LCD readout should display a frequency expressed in GHz that is slightly lower than the low frequency end point of the microwave unit being used.

NOTE

When using a microwave unit that requires an external RF source, the display will read 0.00 V ±60 mV with the TUNE control rotated fully counterclockwise.

2.9.5.3. Rotate TUNE control knob fully clockwise. The LCD readout should display a frequency expressed in GHZ that is slightly higher than the upper frequency end point of the microwave unit being used.

NOTE

> When using a microwave unit that requires an external source, the display will read >10.00 V with the TUNE control rotated fully clockwise.

2.9.6. Sweep Generator Preoperational Check. To verify proper function of the multimeter's sweep generator capability, proceed as follows:

2.9.6.1. Switch power off momentarily, then turn it back on.

2.9.6.2. After the LCD readout displays .000 VOLTS, press 2nd and SWEEP GEN. The LCD readout should alternately display the upper and lower frequency end points of the microwave unit, while the OSC ON lamp of the microwave unit is lit.

NOTE

> When using a microwave unit which requires an external signal source (7200 series) the LCD readout will display 0.00 to 10.00 volts corresponding to the upper and lower end points of the tuning head.

2.9.7. Voltmeter Preoperational Check. To verify proper function of the multimeter's voltmeter capability, proceed as follows:

2.9.7.1. Plug red test probe into red jack and black test probe into black jack on multimeter panel.

2.9.7.2. Press VDC. LCD readout should now display ".000 VOLTS" (±.003V), with the leads shorted together.

2.9.8. Remote Preoperational Check. See paragraph 2.18 for preoperational check of the IEEE 488 and the IEC 625-1 options. A preoperational check of either interface is fully integrated into the operation procedure of both options.

2.10. GENERAL OPERATING INSTRUCTIONS.

These instructions will show how to calibrate for and then perform each of the following measurements: Power, Insertion Loss, Reflection and DC Voltage. Also discussed, are selection of frequency end points, XY plot, insertion loss, application notes, alternate display modes, using the multimeter as a signal generator, and remote operation of the multimeter.

NOTE

Review Interconnect and Turn-on Procedures (paragraph 2.8) before proceeding with Operating Instructions.

CAUTION

Do Not use excessive force when mating connectors on the Microwave Unit supplied with your system. Cross threading, over torquing or other damage to connectors may degrade the accuracy of the Microwave Multimeter.

NOTE

The multimeter will initiate a calibration cycle if it does not have valid calibration data in its memory for the measurement to be selected.

NOTE

The operator should initiate the calibration cycle if there has been a significant temperature change or time span since the last cycle. The calibration cycle can be initiated at any time by depressing 2nd and CALIB .

2.11. POWER METER OPERATION.

The following paragraphs will guide the operator through calibration and measurement procedures, for power measurements. If additional calibration information is needed, refer to Section IV of this manual.

2.11.1. Depending upon your desired format, press either dBm or µW mW .

WARNING

> Do not exceed 20 Volts AC or DC or + 23 dBm (200 mW) RF power input to the detector.

2.11.1.1. Connect the detector to the test port of the signal source that is to be measured.

2.11.1.2. Press 2nd and CALIB . The LCD readout will display "rF OFF."

2.11.1.3. Turn off the power from the RF source that is to be measured. If the RF source cannot be turned off, remove the detector from the test port of the RF power source; then press CONT . After the multimeter has automatically zeroed, the LCD readout will display "dut."

2.11.1.4. Press CONT . The LCD readout will display "Ur."

2.11.1.5. Press FREQ DISP and adjust the tune control until the LCD readout displays a frequency that is within 100 MHz of the frequency at which power is being measured. This sets the appropriate detector calibration factor for the power measurements.

2.11.1.6. Press either dBm or μW mW . The LCD readout will display "Ur."

2.11.1.7. Power may now be turned on for measurement and the detector connected to the RF source. The LCD readout will display the power measured in either dBm, μW or mW according to your chosen format.

2.11.1.8. The calibration factor may be reset at any time without rezeroing the multimeter, by pressing FREQ DISP , tuning to the RF frequency and then pressing dBm or μW mW .

2.11.1.9. To rezero the multimeter at any time in the power meter mode, press 2nd and CALIB . The sequence starting at 2.11.1.2 will be repeated.

2.11.2. If the microwave unit is changed or if the system's ambient temperature has been changed more than 5°C, proceed with the following instructions.

2.11.2.1. Connect the detector to the output port of a calibrated 1 milliwatt 50 MHz or 100 MHz power reference source.

2.11.2.2. Press 2nd and CALIB . The LCD readout will display "rF OFF."

2.11.2.3. Switch the reference source off.

2.11.2.4 Press CONT . The LCD readout will display "dut."

2.11.2.6. Again, press CONT . This time, the LCD readout will display "Ur."

2.11.2.6. Press FREQ DISP and turn the tune control knob fully counterclockwise.

2.11.2.7 Press either dBm or µW mW (See 2.11.1)

2.11.2.8. Turn on the known 1 milliwatt power reference source.

2.11.2.9. Adjust the calibration pot marked "CAL" on the front panel of the microwave unit, until the LCD readout on the multimeter reads either 0.00 dBm or 1000 µW.

2.11.3 Measuring the Power out of the Microwave Unit. When using a 7000A with serial number above 4000 the power meter function can be used to measure the output power of the microwave unit (or any power dependent on the unit's internal oscillator) by following the procedure given below. This capability is useful when measuring power level dependent devices such as amplifiers (compression point measurements) and mixers.

2.11.3.1. To measure power levels with the internal oscillator on procede as follows:

2.11.3.1.1. Press dBm or µW mW and then momentarily press PUSH FOR CW . The "osc on" LED on the microwave unit will light and the LCD will indicate power.

2.11.3.1.2. Connect the detector to the test point of interest (J1 or the output of an attenuator or amplifier connected to J1, etc). The power level will be displayed on the LCD.

2.11.3.1.3. Pressing FREQ DISP will cause the output frequency to be displayed on the LCD. This frequency is controlled by the front panel "Tune" pot.

2.11.3.1.4. Pressing dBm or µW mW will once again cause power to be displayed. The power meter will automatically be set for the proper calibration factor for the last frequency displayed while in FREQ DISP mode.

2.11.3.1.5. Pressing PUSH FOR CW again will turn off the internal oscillator while leaving the unit in power meter mode. Repetatively pressing PUSH FOR CW will cause the oscillator to turn on and off in toggle switch fashion.

2.11.3.1.6. The 7000A's microprocessor will automatically reset all controls to their proper settings when leaving this mode of operation to go to another one (Insertion Loss, Sweep Generator, etc.). The power meter calibration factor will be left to correct for the last frequency displayed while in power meter mode.

NOTE

> This mode of operation may also be used with microwave units requiring an external source (7200 series) however the power meter calibration factors must be set while the unit is in power meter mode with the "osc on" LED off. Press dBm and FREQ DISP the "GHZ" annunciator should be on. Set the display to the proper frequency using the Tune pot and then press dBm to enter the new calibration factor. If the "volts" annunciator is on when FREQ DISP is pressed then the unit is not in the right mode. Follow the instructions given in para. 2.11 to 2.11.1.9 above.

2.12. END POINT (lower/upper) FREQUENCIES SELECTION.

When the multimeter is turned on, the full frequency range of the microwave unit will automatically be used. If the operator desires other frequency end points he may select them by using the following procedure:

2.12.1. Press 2nd and then SIG GEN . This will put the multimeter in signal generator mode.

2.12.2. Adjust the TUNE control knob on the front panel until one of the desired frequency end points shows on the LCD readout.

2.12.3. Press 2nd and ENTER . This will enter the frequency end point located in step 2.12.2 above, into memory, Refer to note 2.12.6.1.

2.12.4. Repeat steps 2.12.1 through 2.12.3 above to set the other frequency end point on the LCD readout.

2.12.5 The two frequency end points that were shown on the LCD readout during steps 2.12.2 and 2.12.4 will now be retained in memory until other points are entered, or until the multimeter is turned off.

2.12.6. VOLTAGE/FREQUENCY CORRELATION FOR 7200 MICROWAVE UNIT.

2.12.6.1. When using a 7200 Series Microwave Unit the frequency information displayed by the 7000A is normally in terms of a voltage which can range from 0 to 10 volts (the limits of the SWEEP OUT ramp used to control an external source). To facilitate the use of the 7000A with an external source the Voltage/Frequency Correlation function provides the capability of defining a relationship, or correlation, between voltage and frequency. As described in the following procedure two frequencies are defined where the lower frequency is equated to 0 volts and the higher frequency to 10 volts. After this relationship is defined, all frequency data will be displayed in GHz.

2.12.6.2. Press 2nd and then SWEEP GEN . This will put the system in sweep generator mode.

2.12.6.3. Press 2nd and then CALIB . This will cause the unit to enter a mode where it is expecting a new voltage/frequency relationship to be defined. Regardless of what relationship or end points were previously defined the LCD readout will now show the 0 and 10 volt end points.

2.12.6.4. At this point two options exist. Either retain the 0 to 10 volt limits (perform operation described in paragraph 2.12.6.5.) or define a new voltage/frequency correlation (perform operation outlined in paragraph 2.12.6.6. thru 2.12.6.10.).

2.12.6.5 To retain the default voltage limits, press 2nd and then ENTER . The unit will enter the sweep generator mode with the 0 and 10 volt endpoints displayed on the LCD readout. END OF PROCEDURE.

2.12.6.6. To define a new voltage/frequency relationship press CONT . The LCD readout will now display frequency data that depends on the setting of the TUNE control which can be adjusted from 10 MHz to 20 GHz.

2.12.6.7. Adjust the TUNE control until one of the desired frequency end points appears on the LCD readout. Press CONT to make the 7000A remember this frequency.

2.12.6.8. At this time the 7000A will use 2.0 GHz as the default value for the second frequency. If 2.0 GHz is to be the second end point this procedure can be complete as described in paragraph 2.12.6.10.

2.12.6.9. If a second frequency other than 2.0 GHz is required, then the procedure described above is repeated – adjust (TUNE) control to set frequency and press [CONT]. If more than two frequencies are set prior to completing this sequence, only the last two will be used.

2.12.6.10. To complete the procedure press [2nd] and [ENTER]. The frequencies will be set – low frequency to 0 volts and high frequency to 10 volts – and the 7000A will enter the sweep generator mode alternately displaying the frequency end points on the LCD readout. All frequency data will now be displayed in GHz according to the relationship defined until such time that either the voltage limits (0 and 10 volts) or a new frequency relationship is entered. CAUTION: DO NOT MAKE ANY CHANGES OR ADJUSTMENTS TO THE SWEEP GENERATOR WITHOUT UPDATING THE END-POINTS PROGRAMMED ON THE 7000A.

2.12.6.11. NOTES ON END POINT SETTING.

2.12.6.12. After the first end point has been entered into memory, the multimeter automatically goes into SWEEP GEN mode, alternately displaying the lower and higher frequency points. This feature allows the operator to verify that correct points have been selected.

2.12.6.13. Only the last two end points selected and entered into memory will be used by the multimeter. Prior end points are discarded and must be re-entered if they are to be used again.

2.12.6.14. The multimeter will automatically perform the recalibration that is required whenever new end points are entered.

2.12.6.15. The multimeter will always measure from the lower to the higher frequency end point regardless of the sequence in which they were entered.

2.12.6.16. The single frequency measurement point, which is also the selectable point in auto step mode, will always have the full frequency range of the microwave unit being used available by use of the tune control knob, regardless of the end points set for auto step and sweep modes. This means that a component such as a band pass filter can be checked at a selected point outside its frequency band. Care should therefore be taken to avoid inadvertent out of band measurements. If a single frequency point that is outside of the end point range is being used, it has to be set prior to calibration. Once calibrated it should only be changed to be placed inside the end point range. Otherwise, errors will occur at the variable point.

2.13. INSERTION LOSS.

The following paragraphs cover the measurement of insertion loss. First the standard calibration cycle procedure is given, then the standard measurement cycle procedures and last the calibration and measurement procedures for some special applications. The multimeter will step the operator thru the calibration cycle whenever one is required to make measurements. See Figure 2-8 for a block diagram that explains change of events for insertion loss and reflection measurements.

2.13.1. Calibration for Insertion Loss Measurements. (Ref. Figure 2-9) To calibrate for standard Insertion Loss Measurements, proceed as follows:

2.13.1.1. Set the end points, if less than the full frequency range of the microwave unit is desired. (Ref. paragraph 2.12)

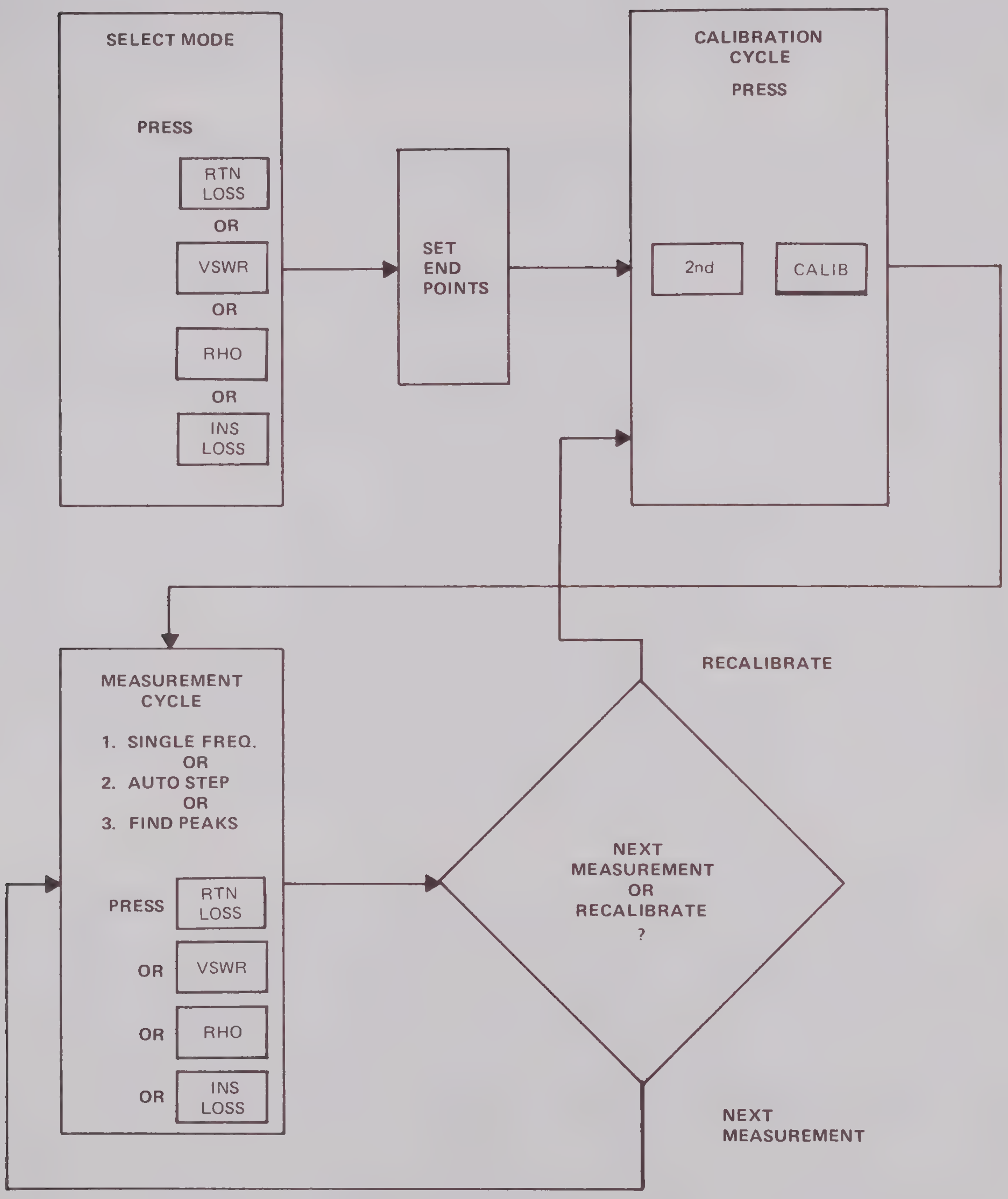
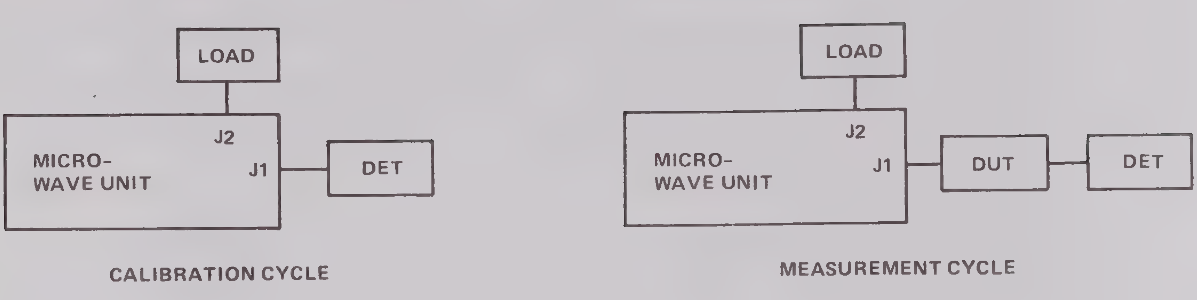

SELECT MODE
PRESS
RTN LOSS
OR
VSWR
OR
RHO
OR
INS LOSS
SET END POINTS
CALIBRATION CYCLE
PRESS
2nd
CALIB
MEASUREMENT CYCLE
1. SINGLE FREQ.
OR
2. AUTO STEP
OR
3. FIND PEAKS
PRESS
RTN LOSS
OR
VSWR
OR
RHO
OR
INS LOSS
NEXT MEASUREMENT OR RECALIBRATE ?
RECALIBRATE
NEXT MEASUREMENT

Figure 2-8. Measurement of Reflection or Insertion Loss: Flow Diagram



CALIBRATION CYCLE

MEASUREMENT CYCLE

Figure 2-9. Microwave Unit Configuration: Insertion Loss

2.13.1.2. Press INS LOSS . The LCD will display "DET", "TO", "J1".

2.13.1.3. Connect the detector to J1 on the microwave unit. Use adapters if necessary.

2.13.1.4. Press CONT . The LCD will display "LOAD", "TO", "J2".

2.13.1.5. Connect the 50 ohm load (Termination) supplied with the multimeter RF unit to J2 of the microwave unit.

2.13.1.6 Press CONT . The multimeter will now zero itself on all ranges and measure 52 reference power levels across the RF band. After the operation is completed the LCD will display "dut". The multimeter is now calibrated and ready to measure insertion loss in single frequency, auto step or CW mode. 7000A's with serial numbers above 4000 are able to keep both insertion loss and reflection calibrations simultaneously thus avoiding the need to repetatively recalibrate when switching between these modes.

2.13.2. Making Single Frequency Insertion Loss Measurements. (Refer to Figure 2-9 for block diagram.) Single frequency insertion loss measurements are made using the following procedure:

2.13.2.1. Select "SINGLE FREQ" position on the white rocker switch.

2.13.2.2. Connect the device under test between J1 and the detector. Then press INS LOSS . The insertion loss is now continuously measured and updated on the LCD readout.

2.13.2.3. Press FREQ DISP . The LCD will display the frequency of the source.

2.13.2.4. Adjust the "TUNE" Control for the desired frequency.

2.13.2.5. Press INS LOSS . Insertion loss is now continuously measured and updated on the LCD display for the new frequency.

2.13.2.6. Repeat 2.13.2.3, 2.13.2.4 and 2.13.2.5 for other frequencies if desired.

2.13.2.7. Connect a new device between J1 and the detector. Then repeat steps 2.13.2.2 through 2.13.2.6 to obtain its insertion loss, or press 2nd and CALIB to start a new calibration cycle.

2.13.3. Making "AUTO STEP" Insertion Loss Measurements. "AUTO STEP" measurements are made similar to single step measurements. The procedure is as follows:

2.13.3.1. After the calibration cycle is completed, select "SINGLE FREQ" position on the white rocker switch.

2.13.3.2. Press FREQ DISP . The LCD will display the frequency of the selectable measurement point.

2.13.3.3. Adjust the "TUNE" Control for the desired selectable point.

2.13.3.4. Select "AUTO STEP" position on the white rocker switch.

2.13.3.5. Press 2nd and 12 PTS to select 12 measurement points or press 2nd and 52 PTS to select 52 measurement points.

2.13.3.6. Press 2nd and either MIN MAX , DISP STEP or DISP WAIT depending upon the display mode required.

2.13.3.7. Connect the device under test between J1 and the detector.

2.13.3.8. Press INS LOSS . Assuming that MIN MAX mode was elected, after the measurements are made the LCD will display the maximum insertion loss measured. If DISP STEP or DISP WAIT has been selected, refer to 2.15. Alternate display modes in AUTO STEP.

2.13.3.9. Pressing FREQ DISP repetitively displays:

a) Frequency of maximum value
b) Minimum value
c) Frequency of minimum value
d) Maximum value, etc. as shown in Figure 2-16.

2.13.3.10. Measurement on a new device may be performed by connecting the device between J1 and the detector.

2.13.3.11. Either repeat steps 2.13.3.7 and 2.13.3.8 to obtain its insertion loss, or press 2nd and CALIB to start a new calibration cycle.

2.13.4. Finding peak values (maximum or minimum) of insertion loss. The procedure for determining peak values is as follows: (Refer to Figure 2-10.)

NOTE

> This mode of operation is used primarily as a fail-safe against discontinuities between measurement points. The multimeter therefore has a distinct advantage over standard digital systems which can only step at given increments and possibly miss these discontinuities completely. However, because of the output level variation of the microwave unit across its band and the wide dynamic range of the peaking meter, minor deviations in the device under test will not be detectable. Use sweep mode for more resolution.

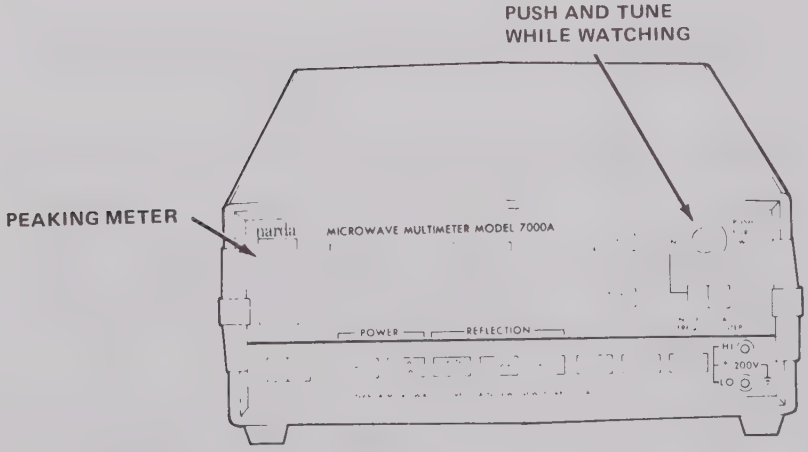

PUSH AND TUNE WHILE WATCHING
PEAKING METER
narda
MICROWAVE MULTIMETER MODEL 7000A
POWER
REFLECTION
HI
200V
LO

Figure 2-10. Finding Peak Values

2.13.4.1. After the calibration cycle is completed, select single frequency measurements and proceed as before.

2.13.4.2. Press PUSH FOR CW and keep the knob held down. In this condition, the "OSC ON" led indicator on the microwave unit is lit.

2.13.4.3. Tune the frequency while monitoring the peaking meter for minimum and/or maximum indications. Upward deflection of the needle indicates decreased insertion loss. Downward deflection indicates increased insertion loss.

2.13.4.4. Release the knob when a mimimum or maximum insertion loss is indicated. The LCD will display the insertion loss of the device at the measurement frequency.

2.13.4.5. Press FREQ DISP. The LCD will display the frequency at which either the minimum or the maximum insertion loss occurred. The LCD display will show only the peak that you selected.

2.13.4.6. Repeat steps 2.13.4.2 through 2.13.4.5 for each additional peak measurement.

2.13.5. Insertion Loss Application Notes. The flexibility of the multimeter allows many variations of standard insertion measurements. Some useful variations of these examples follow.

2.13.5.1. Insertion Loss and On-Off Ratio Measurements of PIN switches. Both of these measurements can be made with only one calibration cycle by referring to Figure 2-11 and proceeding as follows:

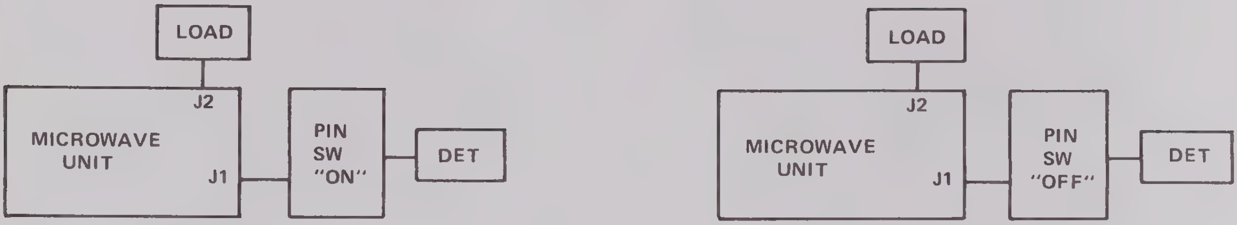
2.13.5.1.1. Calibrate the system with the PIN switch turned on and between J1 and the detector.

2.13.5.1.2. Turn the PIN switch off and press INS LOSS. The data displayed will be the on/off ratio of the switch.

2.13.5.1.3. Remove the PIN switch and connect the detector directly to J1.

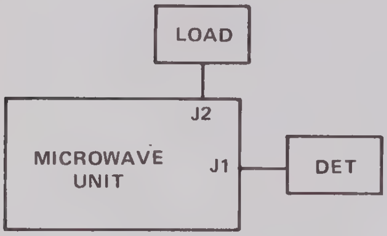
2.13.5.1.4. Press INS LOSS. The magnitude of the data displayed will be the insertion loss of the switch.

2.13.5.1.5. If the PIN switch does not function properly, press VDC. Then use the voltmeter to check out the switch and its bias inputs.


LOAD
J2
MICROWAVE UNIT
J1
PIN SW "ON"
DET
LOAD
J2
MICROWAVE UNIT
J1
PIN SW "OFF"
DET

1) CALIBRATE

2) MEASURE ON/OFF RATIO


LOAD
J2
MICROWAVE UNIT
J1
DET

3) MEASURE INSERTION LOSS

Figure 2-11. Measuring ON/OFF Ratio and Insertion Loss of PIN Switch

2.13.5.2. Measuring the Balance and Insertion Loss of A Power Divider. Both of these measurements can be made with only one calibration cycle by referring to Figure 2-12 and proceeding as follows:

2.13.5.2.1. Calibrate the system with the Power Divider between the Detector and J1, with the unused port(s) terminated.

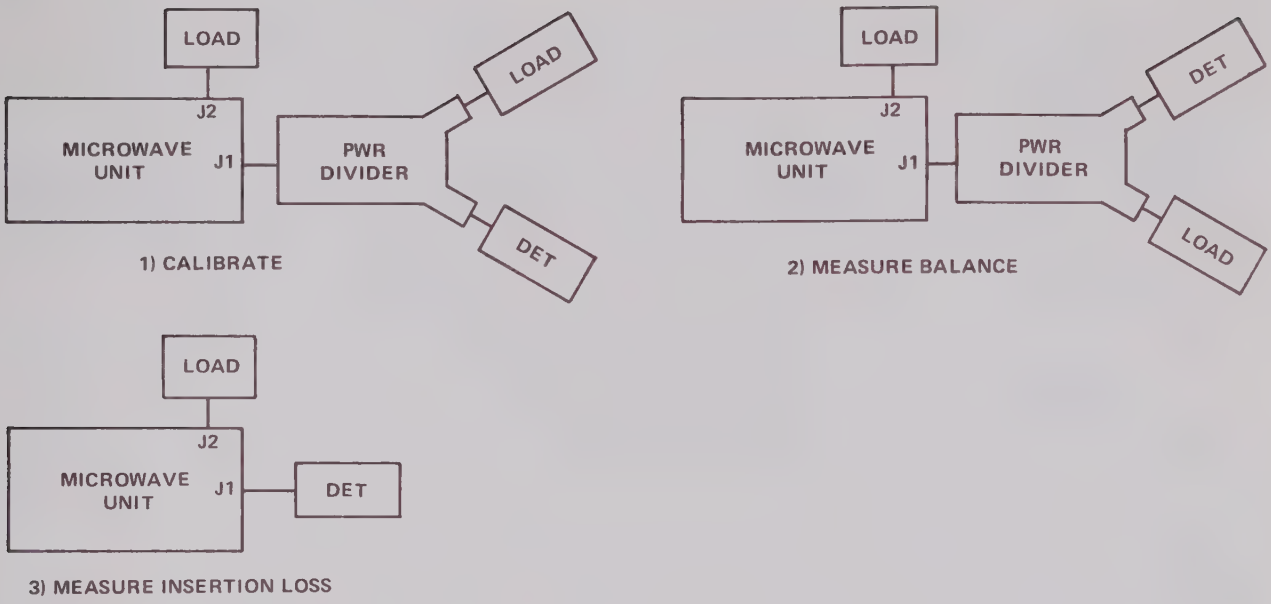
2.13.5.2.2. Move the detector from the port just used to another output port and terminate the original output port.

2.13.5.2.3. Press INS LOSS . The data displayed is the balance between the two ports.

2.13.5.2.4. Repeat steps 2.13.5.2.2 and 2.13.5.2.3 for the other output ports as required.

2.13.5.2.5. Remove the Power Divider and connect the Detector directly to J1.

2.13.5.2.6. Press INS LOSS . The magnitude of the data displayed is the insertion loss of the power divider.


LOAD
J2
MICROWAVE UNIT
J1
PWR DIVIDER
LOAD
DET
LOAD
J2
MICROWAVE UNIT
J1
PWR DIVIDER
DET
LOAD
LOAD
J2
MICROWAVE UNIT
J1
DET

1) CALIBRATE

2) MEASURE BALANCE

3) MEASURE INSERTION LOSS

Figure 2-12. Measuring Balance and Insertion Loss of A Power Divider

2.13.5.3. Measuring the Gain of an Amplifier. The gain of an amplifier can be measured by referring to Figure 2-13 and proceeding as follows:

2.13.5.3.1. Select an attenuator which will keep the input power to the amplifier below its rating (refer to the microwave unit's manual for its output power level) and the output of the amplifier below +13 dbm.

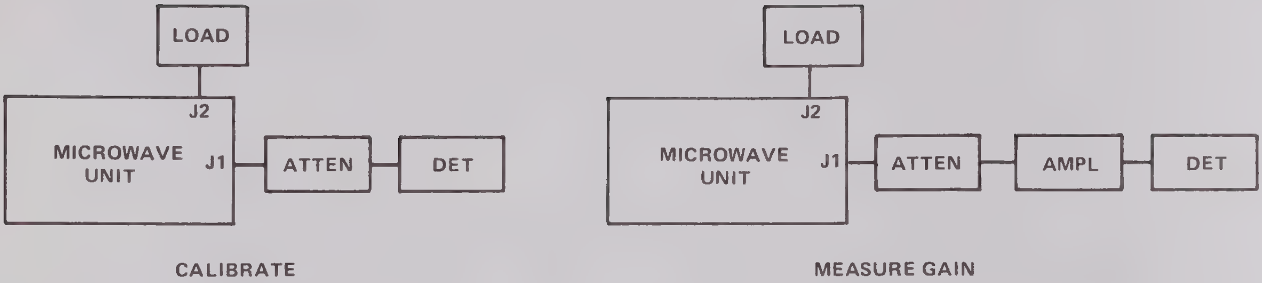
2.13.5.3.2. Calibrate the unit with the attenuator between J1 and the detector.

2.13.5.3.3. Place the amplifier between the attenuator and the detector.

2.13.5.3.4. Press INS LOSS . The data displayed is the gain of the amplifier.

NOTE

The "-" sign preceding a number indicates gain.



CALIBRATE

MEASURE GAIN

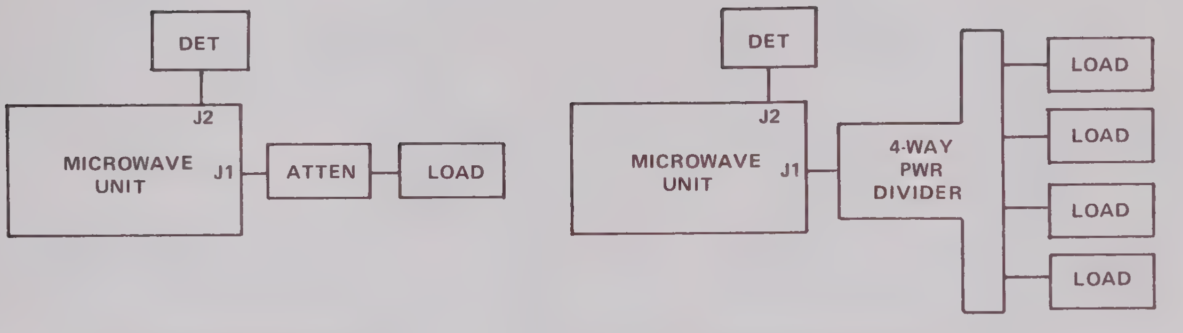
Figure 2-13. Measuring Amplifier Gain

2.14. REFLECTION.

The use of "Single Frequency", or "AUTO STEP" cycles is identical for measuring both reflection and insertion loss. When measuring insertion loss the detector is connected to J1 on the microwave unit and we are looking at incident power. When measuring reflection, the detector is connected to J2 on the microwave unit and we are looking at reflected power. Changing the display selected by pressing any of the three modes, RTN LOSS , VSWR or RHO will not affect measurement and calibration cycles, nor will the multimeter have to be recalibrated, because only the displayed parameter has been changed.

NOTE

When making reflection measurements on devices with multiple ports it is important to terminate each unused port with a precision 50Ω load. (See Figure 2-14.)



REFLECTION MEASUREMENT OF AN ATTENUATOR

REFLECTION MEASUREMENT AT THE INPUT PORT OF A 4-WAY POWER DIVIDER

Figure 2-14. Proper Termination of Multiple Port Devices

2.14.1. Calibration of Reflection Measurements, (ref Figure 2-15). The procedure for calibrating the multimeter for reflection measurements is as follows:

2.14.1.1. Set the end points if less than the full frequency range of the microwave unit is desired. (See paragraph 2.12.)

2.14.1.2. Press RTN LOSS or VSWR or RHO followed by 2nd and CALIB . The LCD will display "det to J2".

2.14.1.3. Connect the detector to J2 of the microwave unit and press CONT . The LCD will display "Sh to J1".

2.14.1.4. Connect a short (supplied with the microwave unit) to J1 on the microwave unit and press CONT . The multimeter will now zero itself on all ranges and then step through 52 calibration points across the band. After this is completed the LCD will display "OP to J1".

2.14.1.5. Connect an open (opposite end of the short supplied with the microwave unit) to J1 and press CONT .

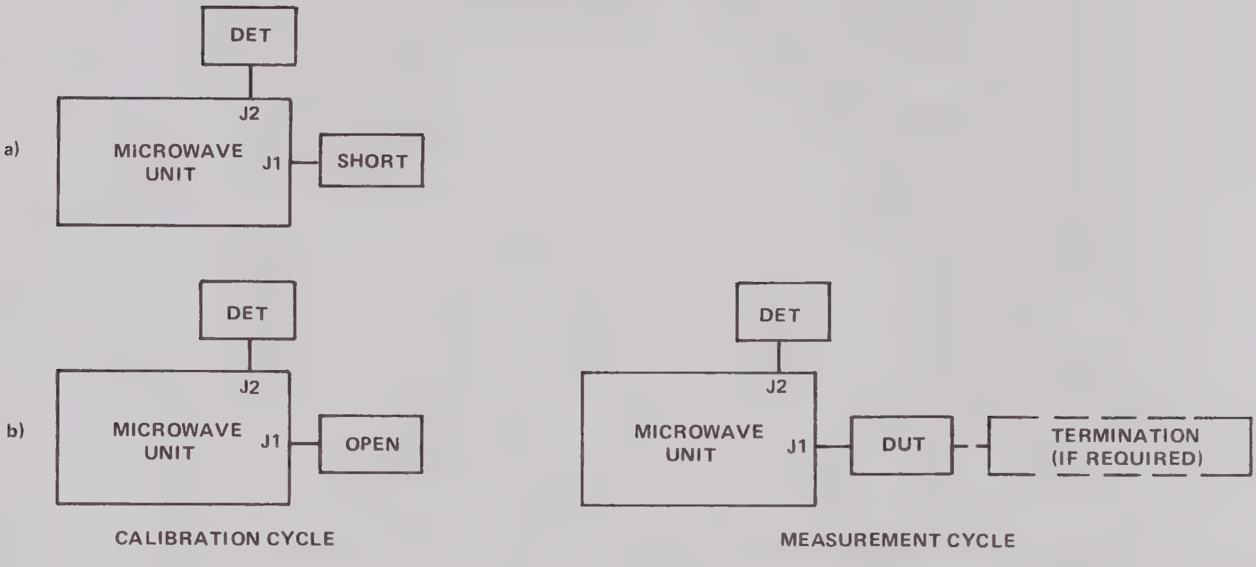

DET
J2
a)
MICROWAVE UNIT
J1
SHORT
DET
J2
b)
MICROWAVE UNIT
J1
OPEN
CALIBRATION CYCLE
DET
J2
MICROWAVE UNIT
J1
DUT
TERMINATION (IF REQUIRED)
MEASUREMENT CYCLE

Figure 2-15. Microwave Unit Configuration: Reflection Measurements

2.14.1.6. The multimeter will now rezero itself on all ranges (if required) and then step through the same 52 calibration points. After this is completed the LCD will display "dut". The multimeter is now completely calibrated for reflection measurements.

2.14.2. Making Reflection Measurements (Refer to Figure 2-15 for block diagram).

2.14.2.1. Press either 2nd and 12 PTS to select twelve measurement points or press 2nd and 52 PTS to select fifty-two measurement points.

2.14.2.2. Press 2nd and then either MIN MAX or DISP STEP or DISP WAIT according to the desired display.

2.14.2.3. Connect the device under test to J1 and press RTN LOSS or VSWR or RHO . The multimeter will make the measurements and display the results in whichever of the three formats the operator has selected.

2.14.2.4. "SINGLE FREQ," "AUTO STEP" and "PUSH FOR CW" are used in the same way as in insertion loss.

2.15. ALTERNATE DISPLAY MODES IN AUTO STEP.

With the white rocker switch set for "AUTO STEP," the operator can change to any of the three display modes from the present setting, except while the multimeter is actually making measurements. Should a display mode change be made during a measurement cycle, the measurement must be re-initiated by pressing (according to the desired measurement parameter) one of the following buttons: RTN LOSS , VSWR , RHO or INS LOSS . The multimeter will not continue to make measurements if the display mode is interrupted. Changing the display mode will not require recalibration of the multimeter. The following notes covering "AUTO STEP" operation explain secondary (2nd) functions of MIN MAX , DISP STEP and DISP WAIT .

2.15.1. Reflection and Insertion Loss Meaurements. When making reflection or insertion loss measurements in "AUTO STEP" operation, three modes of displaying the data are available. They are, MIN MAX , DISP STEP and DISP WAIT . To activate any one of these modes, first press 2nd , then press the display mode button desired.

2.15.2. Displaying the Minimum and Maximum Values. By pressing 2nd and MIN MAX , the operator causes the multimeter to step through all the measurements and to display the maximum and minimum values with their corresponding frequencies. When the multimeter is first turned on the MIN MAX mode is automatically chosen. In "AUTO STEP" operation after the measurements are made the LCD will display the maximum value measured. Pressing FREQ DISP repetitively displays:

2.15.2.1. Frequency of maximum value
2.15.2.2. Minimum value
2.15.2.3. Frequency of minimum value
2.15.2.4. Maximum value, etc. as shown in Figure 2-16. The multimeter remains in the MIN MAX mode until either DISP STEP or DISP WAIT is selected by the operation. Should the operator change to DISP STEP or DISP WAIT mode and then want to return to "MIN MAX" it is only necessary to again press 2nd and MIN MAX .

2.15.3. Display Data on each Frequency Step. By pressing 2nd and DISP STEP , the operator causes data obtained at each frequency to be momentarily displayed on the LCD readout. The multimeter moves step by step, taking measurements and displaying them at each step, until measurements have been made at all the required frequency points. After the last measurement has been made, the LCD readout then displays the maximum value. Pressing FREQ DISP will then function as in MIN MAX display mode. For

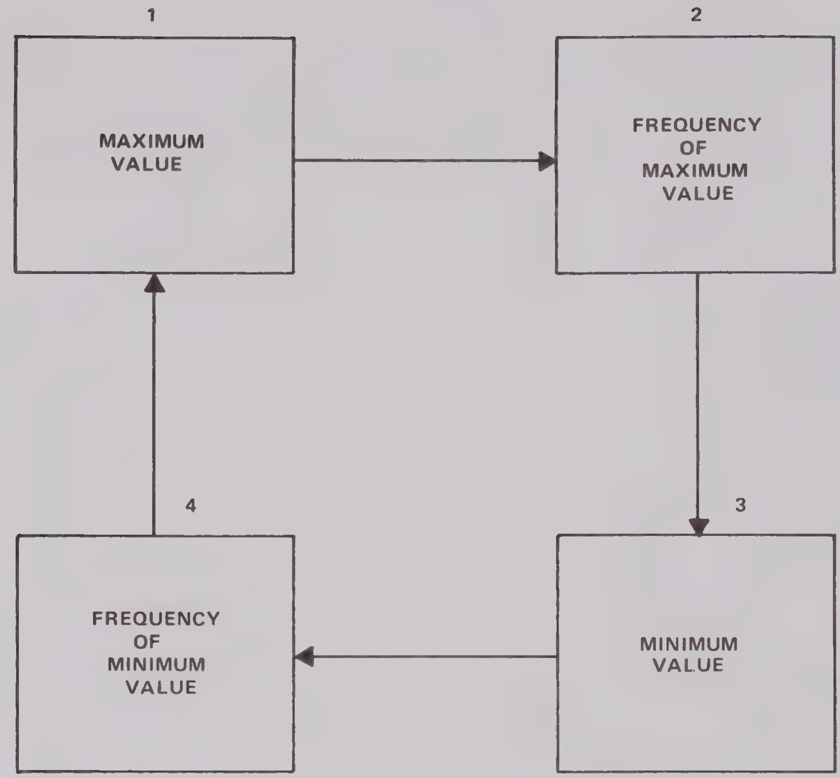

1
MAXIMUM VALUE
2
FREQUENCY OF MAXIMUM VALUE
3
MINIMUM VALUE
4
FREQUENCY OF MINIMUM VALUE

Figure 2-16. Auto Step Data Rotation Using FREQ DISP

NOTE

When the multimeter is first turned on, the following modes are automatically set:

1) 12 PTS Twelve measurement points in "AUTO STEP"
2) MIN MAX Display only maximum and minimum values in "AUTO STEP"
3) End points. Full frequency range of the microwave unit.

These modes will be used unless the operator changes them.

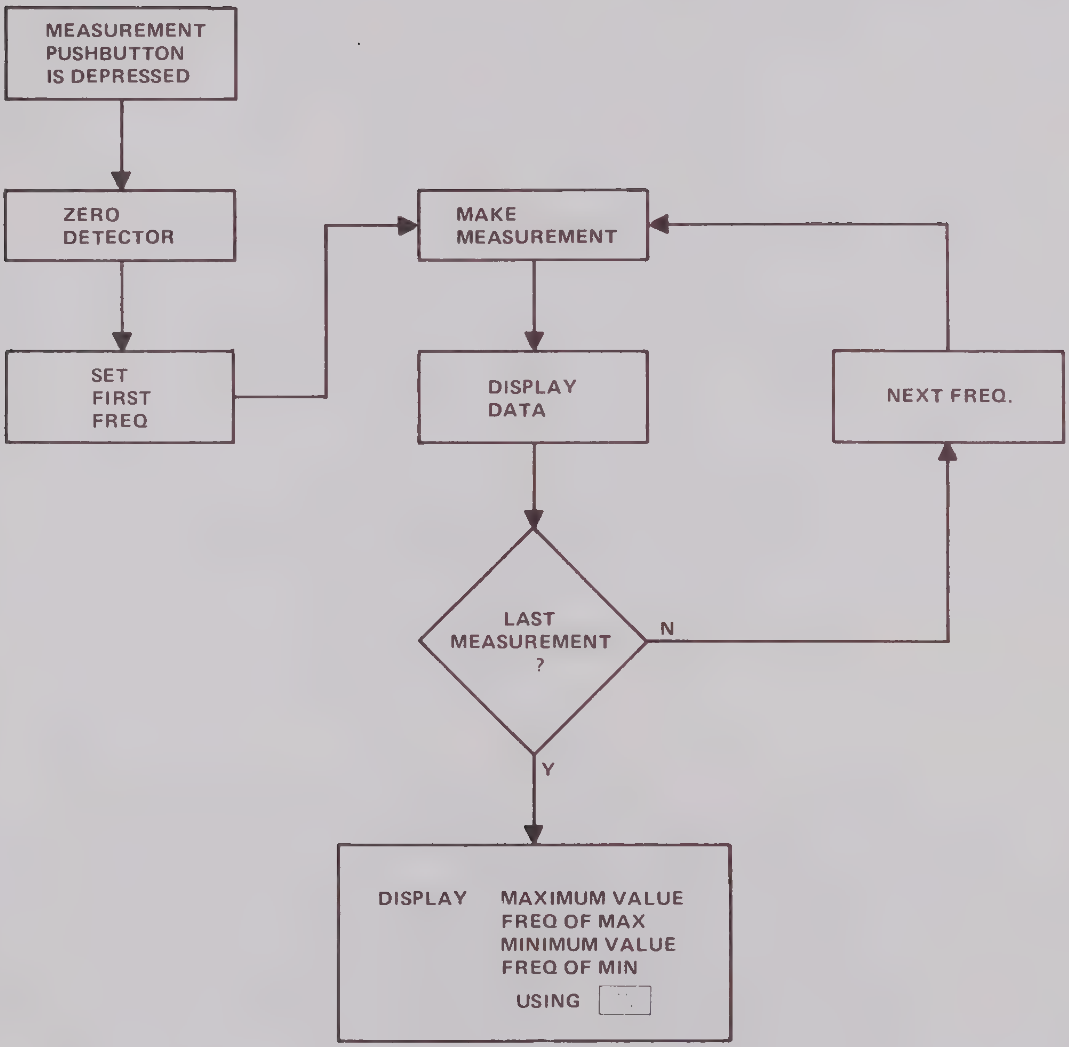

MEASUREMENT PUSHBUTTON IS DEPRESSED
ZERO DETECTOR
SET FIRST FREQ
MAKE MEASUREMENT
DISPLAY DATA
NEXT FREQ.
LAST MEASUREMENT ?
N
Y
DISPLAY
MAXIMUM VALUE
FREQ OF MAX
MINIMUM VALUE
FREQ OF MIN
USING

Figure 2-17. Display Step Mode Block Diagram

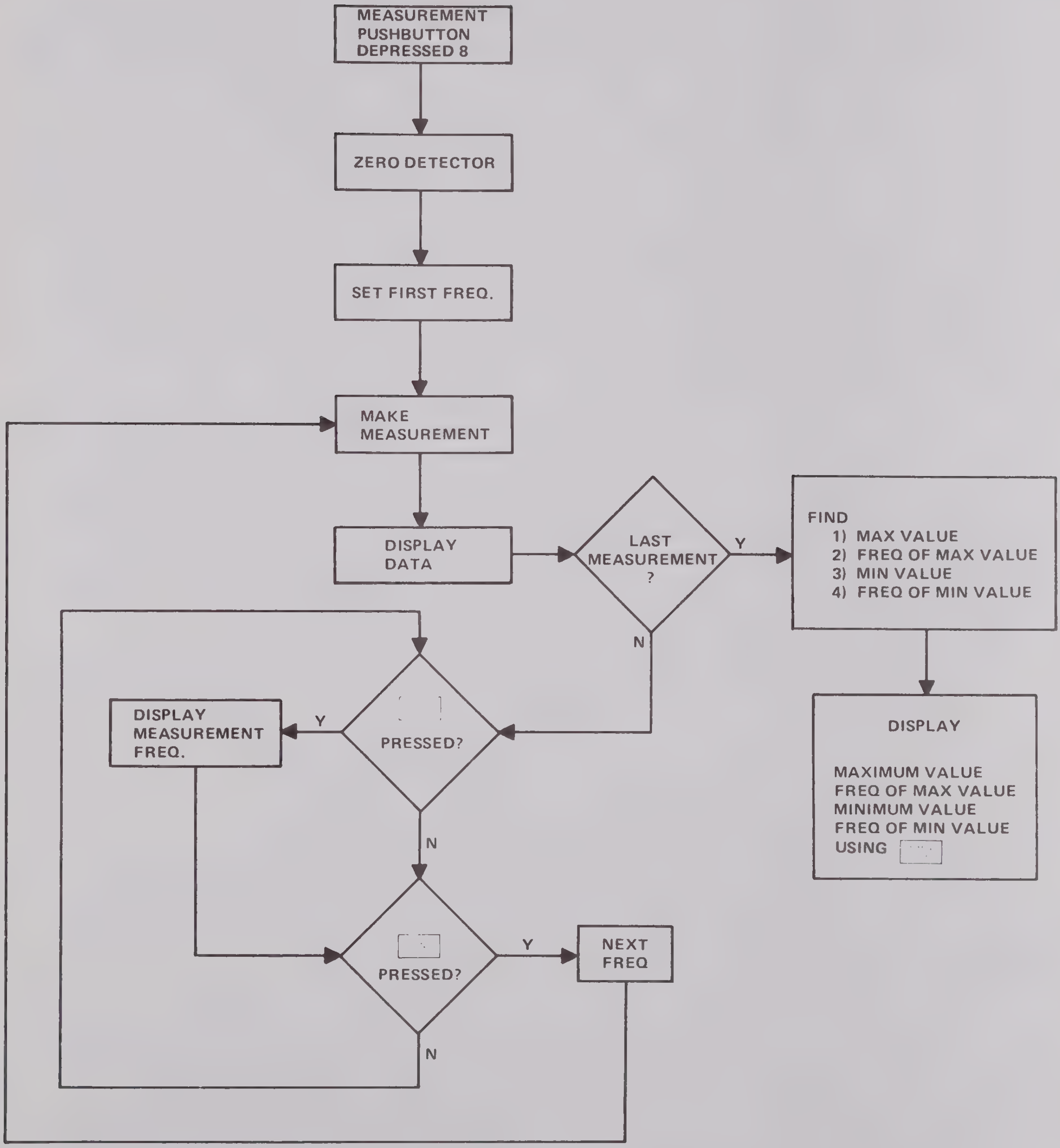

MEASUREMENT PUSHBUTTON DEPRESSED 8
ZERO DETECTOR
SET FIRST FREQ.
MAKE MEASUREMENT
DISPLAY DATA
LAST MEASUREMENT ?
Y
N
FIND
1) MAX VALUE
2) FREQ OF MAX VALUE
3) MIN VALUE
4) FREQ OF MIN VALUE
DISPLAY
MAXIMUM VALUE
FREQ OF MAX VALUE
MINIMUM VALUE
FREQ OF MIN VALUE
USING
PRESSED?
Y
DISPLAY MEASUREMENT FREQ.
N
PRESSED?
Y
NEXT FREQ
N

Figure 2-18. Display Wait Mode Block Diagram

reference, see Figure 2-17 Display Step Mode and Figure 2-8 Measurement of Reflection or Insertion Loss. This mode is most useful with an external printer.

2.15.4. Display Wait. By pressing 2nd and DISP WAIT the operator causes data obtained at the first frequency to be displayed and held on the LCD readout until CONT or FREQ DISP is pressed. If CONT is pressed, the multimeter will go to the next frequency and display the data for that frequency. If FREQ DISP is pressed the frequency of the last measurement will be displayed. Press CONT one time for each frequency point to be measured. After the last measurement has been made, max-min data is available by pressing FREQ DISP. A block diagram of this mode is illustrated in Figure 2-18. CONT and FREQ DISP are the only valid buttons to be pushed in this mode. Push 2nd and MIN MAX to Terminate display wait mode. This mode is most useful when manually recording data.

2.16. SIGNAL GENERATOR/SWEEP GENERATOR OPERATION.

The multimeter can be operated as a signal generator either by pressing 2nd and SIG GEN for manually tuned cw operation, or by pressing 2nd and SWEEP GEN for swept operation. Paragraph 2.16.1 describes operation when used with a 7100 series microwave unit having an internal source, and paragraph 2.16.2 describes operation with a 7200 series microwave unit having an external source.

NOTE

The multimeter may be switched between any other mode and either SIG GEN or SWEEP GEN and back to the original measurement mode without recalibrating.

2.16.1. Microwave Units Having an Internal Source. Refer to the instruction manual of the microwave unit being used for any detailed information that might be required.

2.16.1.1. Manually Tuned CW Operation. Press 2nd and SIG GEN buttons on the multimeter panel. The microwave unit will output a test signal of approximately zero dBm. With the multimeter operating in this mode, the full frequency band of the microwave unit is always available despite any frequency end points that might have been selected and the LCD will display the output frequency in GHz. Output frequency is tuned by rotating the "TUNE" control knob on the front panel of the multimeter.

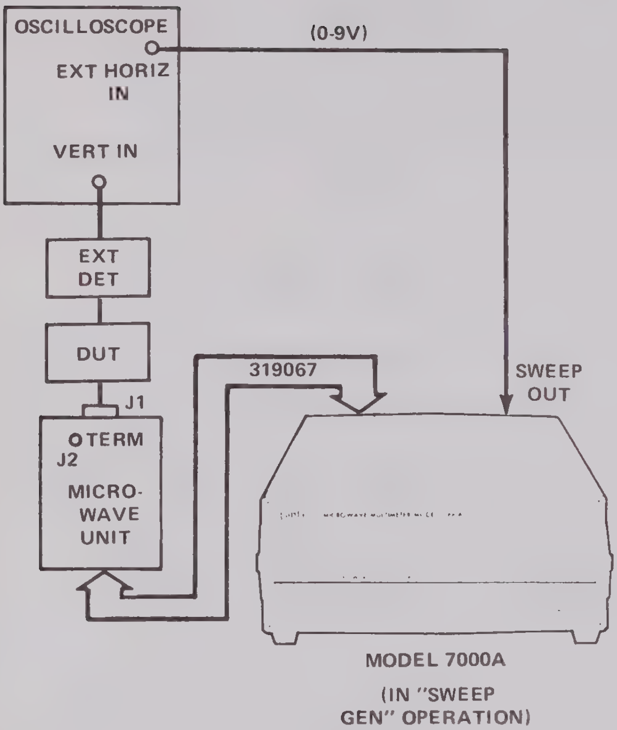

OSCILLOSCOPE
(0-9V)
EXT HORIZ IN
VERT IN
EXT DET
DUT
J1
O TERM
J2
MICRO-WAVE UNIT
319067
SWEEP OUT
MODEL 7000A
(IN "SWEEP GEN" OPERATION)

Figure 2-19A. Insertion Loss/Gain Sweep Generator Operation

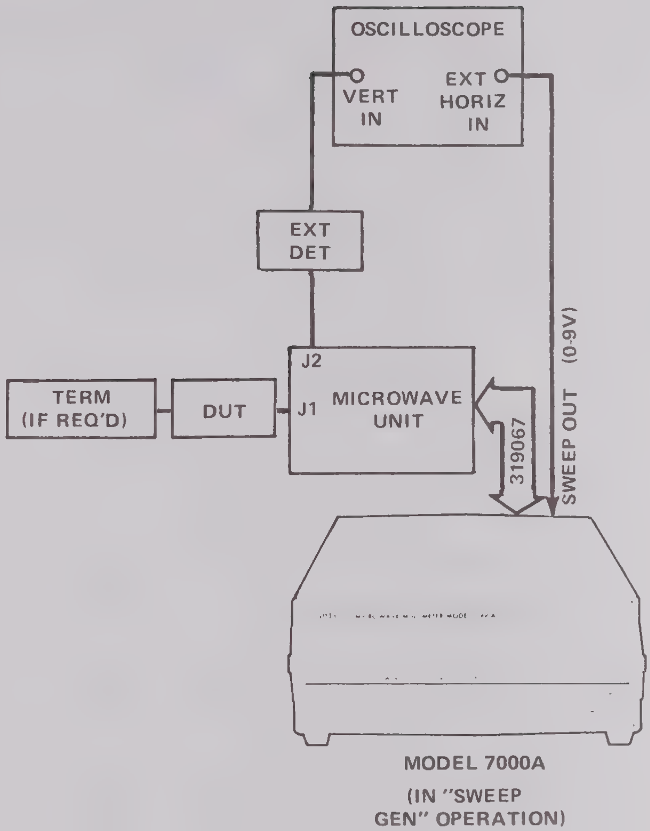
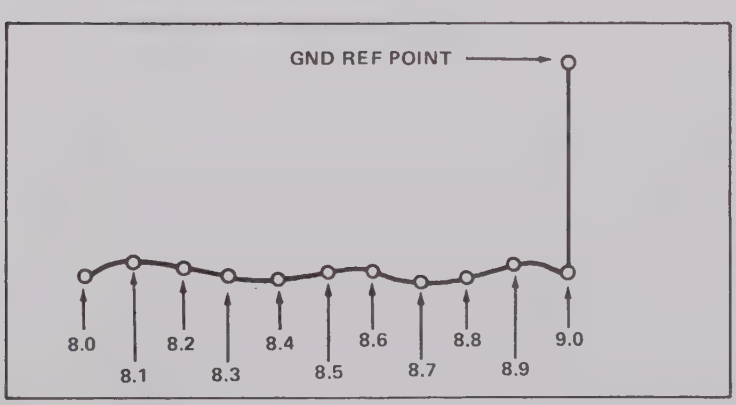

OSCILLOSCOPE
VERT IN
EXT HORIZ IN
EXT DET
J2
TERM (IF REQ'D)
DUT
J1
MICROWAVE UNIT
319067
SWEEP OUT (0-9V)
MODEL 7000A
(IN "SWEEP GEN" OPERATION)

Figure 2-19B. Reflection Sweep Generator Operation



NOTES:

1. ASSUMING END POINTS ARE 8.0 AND 9.0 GHz
2. USING A NEGATIVE OUTPUT DETECTOR

Figure 2-20. Oscilloscope Presentation in Sweep Generator Operation

2.16.1.2. Sweep Operation. Press 2nd and SWEEP GEN buttons on the multimeter panel. The microwave unit's internal oscillator is repetitively swept from the lower frequency end point to the upper frequency end point. (Refer to paragraph 2.12 end (lower/upper) frequencies selection). When used with Narda's model 503 external detector and an oscilloscope, this mode can be used to align a device for transmission or reflection parameters as illustrated in Figures 2-19A and 2-19B. This mode is used to scan for discontinuities or to visually tune and check the shape of the response.

2.16.1.2. Oscilloscope Presentation. When in sweep operation as illustrated in Figure 2-20 the operator will note that there are eleven bright spots along the detector output trace with one additional bright spot at the end of the trace on the ground reference line. The bright spots along the detector output trace are frequency markers. These markers are evenly spaced from the start to the stop frequency. As an example, if the selected frequency end points are 8.0 GHz and 9.0 GHz, the first bright spot will be at 8.0 GHz, the second at 8.1 GHz, the third at 8.2 GHz etc. as illustrated in Figure 2-20. The ground reference point gives the operator a reference to work from.

2.16.2. Microwave Units Requiring An External Source. Refer to the instruction manual of the microwave unit being used for any detailed information that might be required.

2.16.2.1. Manually Tuned CW Operation. Press 2nd and SIG GEN buttons on the multimeter panel. The microwave unit will output a test signal whose power is controlled by the output level of the external source. The output frequency is controlled by rotating the "TUNE" control knob on the front panel of the multimeter. A tuning voltage of zero volts with the "TUNE" control turned fully counterclockwise and +10V with it turned fully clockwise is available at the "V TUNE" BNC connector at the rear panel of the microwave unit. Connect this voltage to the analog external frequency control of the external source. (Reference, Figure 2-21). It should be noted that the model 7202 can be set for a tuning voltage range of -10V to +10V (refer to 7202 Manual, Section II).

2.16.2.2. Sweep Operation. Press 2nd and SIG GEN on the multimeter panel, then proceed as follows:

2.16.2.2.1. Set the external source to its sweep mode and set the end points on the external source.

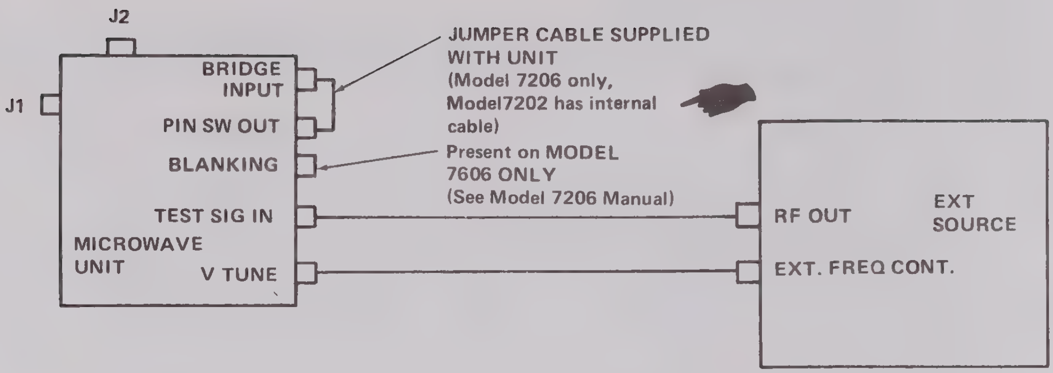

J2
J1
BRIDGE INPUT
PIN SW OUT
BLANKING
TEST SIG IN
MICROWAVE UNIT
V TUNE
JUMPER CABLE SUPPLIED WITH UNIT (Model 7206 only, Model7202 has internal cable)
Present on MODEL 7606 ONLY (See Model 7206 Manual)
RF OUT
EXT SOURCE
EXT. FREQ CONT.

Figure 2-21. Typical External Source Interconnection

2.16.2.2.2. Set the frequency control of the source to "INTERNAL".

2.16.2.2.3. Follow swept operation instructions for the source being used.

2.16.3. Using the Multimeter to Sweep an External Source. The multimeter can be used to sweep if the frequency range to be swept does not require crossing over a band end point of the external source. Sweepers momentarily shut off (blank) the rf power whenever they cross a band end point. The multimeter does not sense for rf blanking pulses; it sweeps continuously. Therefore, if the multimeter is used for sweeping, and a band crossover point is encountered, the resulting rf blank will result in a blank on the oscilloscope trace.

2.16.3.1. Connecting the Multimeter for External Source Sweep. Refer to Figure 2-21 for interconnect instructions, then proceed as follows:

2.16.3.1.1. For best resolution, set the frequency end points on the external source.

2.16.3.1.2. Set the frequency control of the souce to "EXTERNAL."

2.16.3.1.3. Press 2nd and SWEEP GEN on the multimeter panel.

NOTE

If the frequency end points are set on the multimeter, the tuning voltage variation, which varies from 0V at start to 10V at stop full range, will decrease in direct proportion to the percentage of full frequency range used. The start and stop voltages that define the tuning voltage will be alternately displayed on the LCD. See notes on end point setting, paragraph 2.12.6.5.

2.17. DC VOLTMETER OPERATION.

When using the multimeter to measure DC voltage proceed as follows:

WARNING

> Unit is equipped with a third wire protective earth ground circuit. Do not remove this ground inside or outside the unit. On units equipped with an internal battery, option 01, connect ground terminal on rear panel to a good earth ground (⏚) on system under test. Violating these precautions could result in a dangerous electrical shock.

CAUTION

> Do not exceed 500 volts relative to ground.

2.17.1. Plug red test probe into red jack and black test probe into back jack on multimeter panel.

2.17.2. Press $\boxed{\text{VDC}}$.

2.17.3. Perform voltage tests, observing warning and caution notes above. Voltages and polarities will be displayed on the LCD.

NOTE

> The multimeter may be switched between any other mode and $\boxed{\text{VDC}}$ then back to the original mode without recalibrating.

2.18. XY Plot

The XY plot function provides the capability to drive an external XY plotter via the SWEEP OUT signal from the rear panel of the 7000A and, using an external detector, to record an RF power level. See Figures 2-22 and 2-23 for interconnection diagrams when using either a 7100 or 7200 Series Microwave Units. A related function provides the ability to control the sweep time of the SWEEP OUT signal. The following paragraphs describe the procedures necessary for use of the XY plot functions.

2.18.1 Set-up measurement. Select end points in normal manner and perform measurement with internal detector to assure desired results are being achieved.

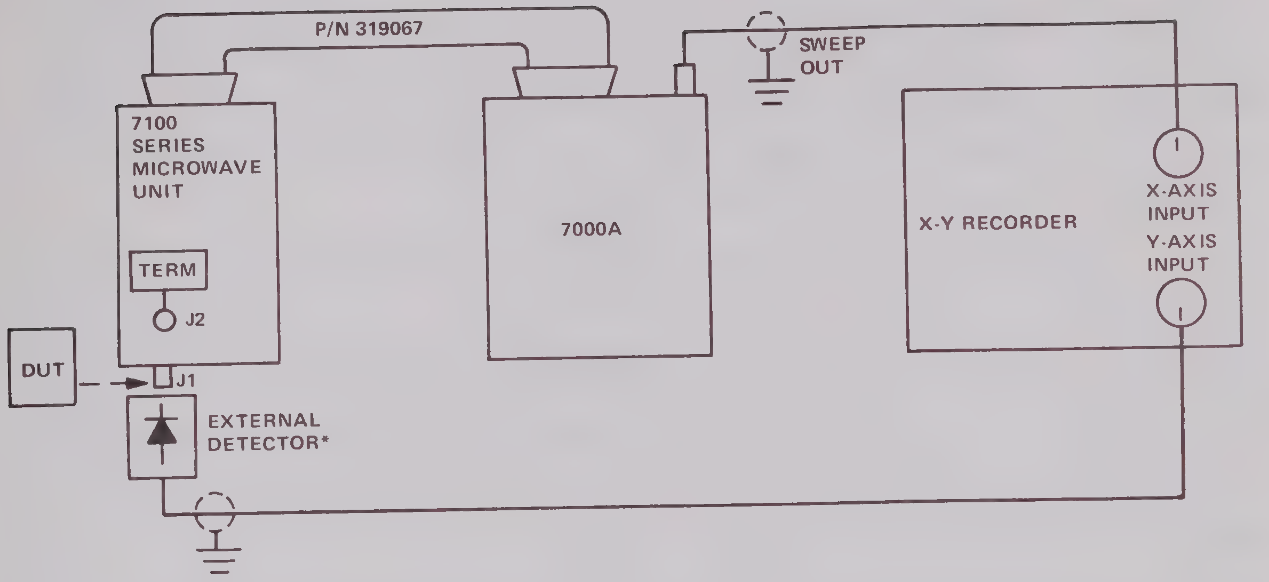
2.18.2. Set XY plot sweep time (optional). Press 2nd and XY . To enter calibration mode which allows setting of sweep time - press 2nd and CALIB .

2.18.3. The LCD readout now displays a number which should be interpreted as the sweep time in seconds. The default sweep time after power-up is ten seconds. Adjusting the tune control allows the setting of this number in a range from 10 to 1000 seconds. (Numbers displayed after the decimal point are not used). When the desired time is displayed, then press 2nd and ENTER to set the sweep time equal to the displayed number. Then proceed as below.

2.18.4. Adjust plotter vertical scaling. Temporarily disconnect plotter X-axis drive connection. Select signal generator mode on 7000A - press 2nd and SIG GEN . Then using an external detector, manually adjust the tuning knob across the frequency range of interest and adjust the vertical gain/offset controls of the plotter to obtain the desired settings. CAUTION: The limits of tuning in the signal generator mode are not determined by the end point settings, so take note of frequency readings on LCD readout to stay within end point limits.

2.18.5. Adjust plotter horizontal scaling. Connect plotter X-axis drive. Select XY plot function - press 2nd and XY . The Plotter pen should move to the left extreme of its current setting. Press 2nd again after the plotter pen settles in this position (3 seconds delay at beginning of sweep provides the time needed to enter this mode). This will cause the sweep to be held at this starting position so that the X-axis offset of the plotter can be adjusted for the desired position. Now press XY again and after the three second delay the plotter pen should begin to move to the right. When it reaches the end of the sweep adjust the X-axis gain for the desired setting. Repeat this step until desired min and max settings for the X-axis are achieved.

2.18.6. Generating plots. The set-up is now ready for normal generation of plots by simply selecting the XY plot mode - press 2nd and XY . Again the three second pause at the beginning allows the operator to drop the pen after the plotter arm has stabilized at the left hand position. At any time during the plot the 2nd button may be pressed which will cause the sweep to stop and remain at its current position. Pressing XY will cause the sweep to restart from the start position. CAUTION: After pressing 2nd to stop a sweep the next button entered will result in its associated 2nd level function being selected. Press VOLTS if no specific function is desired.


P/N 319067
7100 SERIES MICROWAVE UNIT
TERM
J2
DUT
J1
EXTERNAL DETECTOR*
7000A
SWEEP OUT
X-Y RECORDER
X-AXIS INPUT
Y-AXIS INPUT

*See Fig. 2-19A and 2-19B for external detector placement on microwave unit.

Figure 2-22. Interconnection Diagram 7000A, 7100 Series Unit and X-Y Recorder

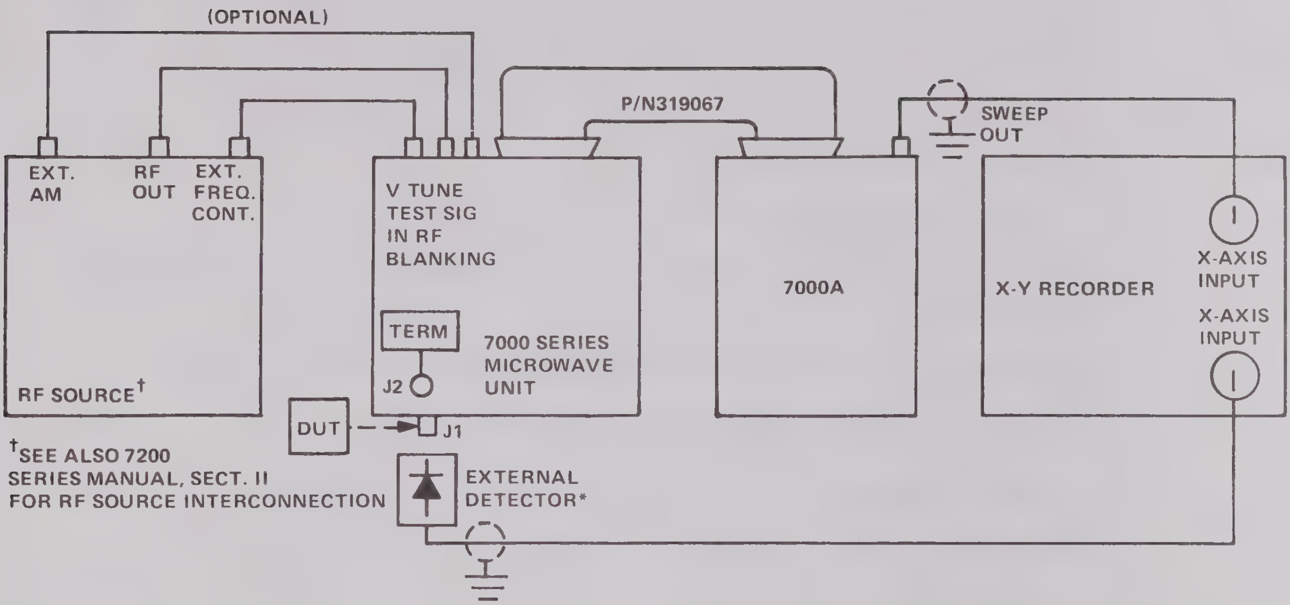

(OPTIONAL)
P/N319067
SWEEP OUT
EXT. AM
RF OUT
EXT. FREQ. CONT.
RF SOURCE†
V TUNE
TEST SIG
IN RF
BLANKING
TERM
J2
7000 SERIES MICROWAVE UNIT
7000A
X-Y RECORDER
X-AXIS INPUT
X-AXIS INPUT
DUT
J1
EXTERNAL DETECTOR*
†SEE ALSO 7200 SERIES MANUAL, SECT. II FOR RF SOURCE INTERCONNECTION

Figure 2-23. Interconnection Diagram 7000A, 7200 Series Unit and X-Y Recorder

2.19. REMOTE OPERATION.

NOTE

> A more detailed explanation of remote operation procedures is given in: APPLICATION NOTE 2 NARDA MODEL 7000A MICROWAVE MULTIMETER - REMOTE PROGRAMMING OVER THE IEEE-488 BUS.

The Narda Model 7000A, when equipped with the -02 option can be remotely controlled by means of the IEEE standard programmable instrument interface bus (GPIB), IEEE Std. 488-1978 or IEC publication 625-1. This standard defines the interface of instrumentation to computers, calculators and systems. Table 2-6 defines the interface capability of the 7000A-02 connected to a GPIB in terms of interface codes

Table 2-6

Interface Code Functions

CODE	INTERFACE FUNCTION
SH1	Source handshake capability
AH1	Acceptor handshake capability
T7	Talker (Basic talker, talk only mode, unaddress to talk if addressed to listen)
L4	Listener (Basic listener, unaddress to listen if addressed to talk)
SR0	No service request capability
RL2	Remote/local capability - No local lockout
PP0	No parallel poll
DC0	No device clear capability
DT1	Device trigger capability
C0	No controller capability
E2	Three state bus drivers

defined in Appendix C of IEEE-Std. 488-1978. These functions define the characteristics of the GPIB interface.

2.19.1. Program Codes. All front panel controls and switches are programmable with the exception of the power line switch. The program codes for each control are listed in Table 2-7. The button codes can also be determined from Figure 2-24 which shows the front panel with the controls labeled with the programming code.

Table 2-7

Control Program Codes

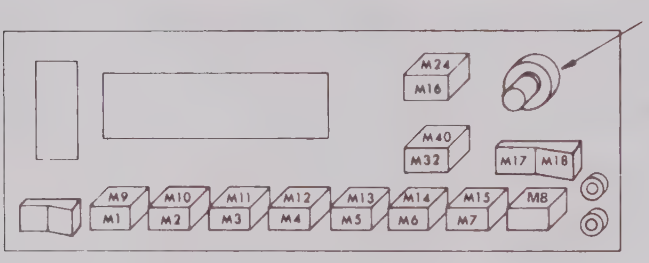
GPIB INPUT CODES	
M - Mode	Corresponds to Button Pushed.
M1	Power (dBm)
M2	Power (mw)
M3	Return Loss (dB)

Table 2-7 (Cont)

M - Mode	Corresponds to Button Pushed.
M4	VSWR
M5	Reflection Coefficient
M6	Insertion Loss (dB); Gain (dB)
M7	Volts
M8	XY Plot
M9	Set system for 12 measurement points for Autostep.
M10	Set system for 52 measurement points for Autostep.
M11	Autostep Mode - min/max.
M12	Autostep Mode - display on each step.
M13	Autostep Mode - Stop on each step. (M32 to display present frequency) (M16 to continue - make next meas.) (M17 to abort Autostep)
M14	Signal Generator
M15	Sweep Generator
M16	Continue
M17	Single Point
M18	Autostep
M24	Calibrate
M32	Display Frequency
M40	Enter end point
M64	Push for CW
FPDDDDD	Input frequency in MHz for power measurement.
FTDDDDD	Input variable point (single point) frequency in MHz.
FXDDDD	Input variable sweep time for XY plot.

2.19.2. Programming the 7000A Multimeter. A system controller and a GPIB interface cable are the minimum required equipment to program the 7000A. Programming

GPIB-IEEE-488-1978 PROGRAMMING CHART



FT DDDDD= Tune Freq. in MHz
FP DDDDD= Freq. for Power Meas. in MHz
FXDDDD= Variable Sweep Time for XY Plot

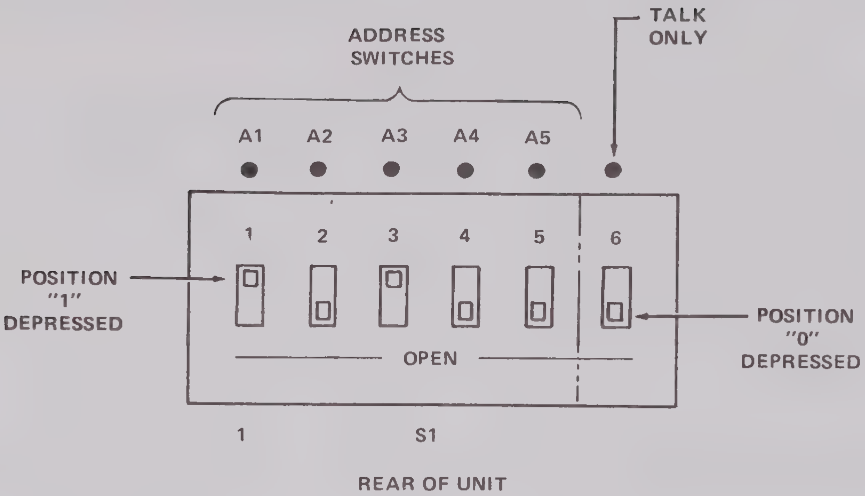
Output Format =±DDDDD.DDDDE± DD SC CRLF
D= ASCII Coded Decimal Digit
SC= Status Code (See Manual)
CRLF= Carriage Return—Line Feed

Figure 2-24. Programming Chart for Remote Operation

consists of sending commands or data messages from the controller to the 7000A. The message is composed of two parts - the address command and the program information.

2.19.2.1. Address Command. The address command contains the "talk" or "listen" address of the 7000A. When this address is received by the 7000A and it matches the address set on the address switches, the 7000A is set to its appropriate "talk" or "listen" active state. Once the 7000A is in the "listen" state the program information can be received by the 7000A.

2.19.2.2. Address Switch Settings. Before attempting to program the 7000A, it is necessary to set the address switches. The switches are preset at the factory for decimal address 5, ASCII character code "talk"-E and "listen"-%. If this address is not suitable, then turn off the 7000A power switch, unplug the line cord and remove the top cover of 7000A. Referring to Figure 2-25, set switch S1 to the required address. Once this is done, replace the top cover, plug in the unit and proceed. The syntax of the address command portion of the data message depends on the system controller. General examples are given in Figures 2-26, 2-27 and 2-28 but it is recommended that the user be familiar with the particular controller being used.


ADDRESS SWITCHES
TALK ONLY
A1
A2
A3
A4
A5
1
2
3
4
5
6
POSITION "1" DEPRESSED
POSITION "0" DEPRESSED
OPEN
1
S1
REAR OF UNIT

ASCII Code Character		Address Switches					5-bit Decimal Code
Listen	Talk	A5	A4	A3	A2	A1	
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
-	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30

ADDRESS SELECTION

Figure 2-25. Address Selection for Remote Operation

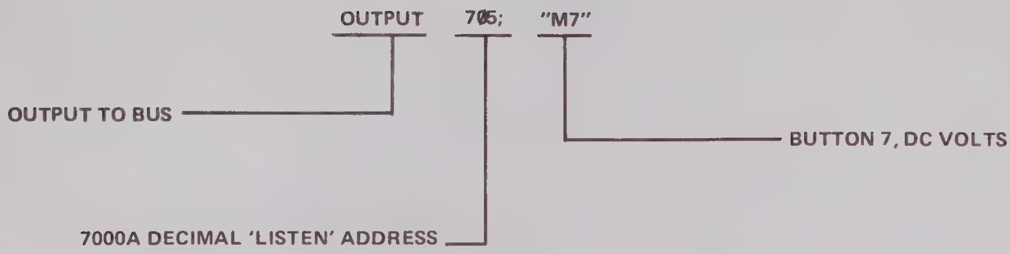

OUTPUT
705;
"M7"
OUTPUT TO BUS
BUTTON 7, DC VOLTS
7000A DECIMAL 'LISTEN' ADDRESS

Figure 2-26. Program Volts DC Message Using the HP 85 Computer

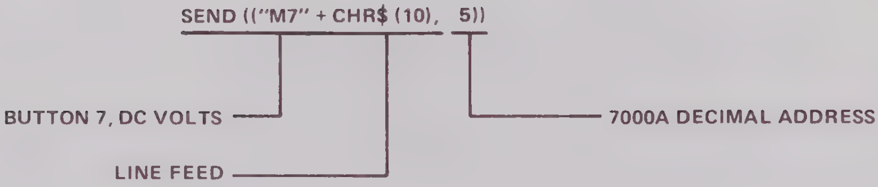

SEND (("M7" + CHR$ (10), 5))
BUTTON 7, DC VOLTS
7000A DECIMAL ADDRESS
LINE FEED

Figure 2-27. Program Volts DC Message Using the Digital Equipment Corporation MINC-11 Computer

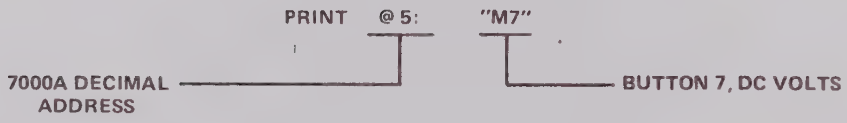

PRINT @ 5: "M7"
7000A DECIMAL ADDRESS
BUTTON 7, DC VOLTS

Figure 2-28. Program Volts DC Message Using Tektronix 4051

2.19.2.3. Program Information. The syntax of the data message is defined by the input codes in Table 2-7. Refer to Figure 2-24 Programming Chart, for program information.

2.19.2.4. Programming for Remote Operation. When programming the 7000A-02, follow the same procedure as for manual operation except, instead of pressing a button, send the appropriate code to the 7000A-02. For example, to program the unit to measure volts DC, send the appropriate "listen" address followed by the code "M7". A line feed character normally sent by the controller terminates the message. The Narda Microwave multimeter will now be in the "volts DC" mode. See Figures 2-26, 2-27 and 2-28 for some typical program data messages.

2.19.3. Power Meter Operation. To set the appropriate detector calibration factor for power meter operation send to the 7000A "FP" followed by the measurement frequency in MHz. Then send either "M1" for dBm or "M2" for mW. As an example:

To measure power in mW at 9250 MHz,

a) Send to 7000A "FP 9250" followed by a line feed to set calibration factor 9250 MHz
b) Send M2 followed by a line feed to set milliwatts

For additional reference, see Figure 2-24 Programming Chart for remote operation and Table 2-7, Control Program Codes.

2.19.4. Remote Operation Without a Controller. Refer to Figure 2-25 and note that the 7000A-02 can be used without a controller to provide output data to another device such as a printer. Set the talk-only switch to the "1" position to activate this mode (refer to paragraph 2.18.2.2). The other device must be GPIB compatible and be set to the "Listen-Only" mode for proper data transfer.

2.19.5. Measurement Data. Referring to Figure 2-29 for 7000A-02 measurement data output format and Table 2-8 for status code definitions, see the following example of a data output from the 7000A-02 for a voltage input of -9.00 volts.

2.19.6. Output Format. Based on a voltage input of -9.00 volts, the 7000A-02 output format will be: -00009.0000 E+00 VD CRLF. The LF character concurrent with EOI is the last character in the data message and must be handshaken to complete the transfer. The 7000A will output data to the bus at the completion of the measurement occurring immediately after it is addressed to "talk". New data is available every time

CAUTION

WHEN READING OUTPUT DATA OVER THE BUS, LEADING ZEROES TO THE LEFT OF THE DECIMAL POINT WITH THE EXCEPTION OF THE UNITS DIGIT AND THE + CHARACTER ARE REPLACED BY SPACE CHARACTERS (ASCII HE 20).

FOR EXAMPLE:

```
b̸b̸b̸b̸b̸2.3400E-00IL
b̸b̸b̸b̸b̸0.7000E-00IL
-b̸b̸b̸b̸0.1230E-00IL
```

b̸ ≡ SPACE CHARACTER

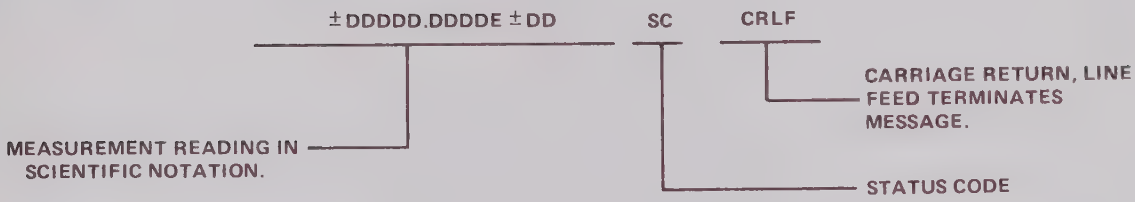

±DDDDD.DDDDE ±DD
SC
CRLF
CARRIAGE RETURN, LINE FEED TERMINATES MESSAGE.
MEASUREMENT READING IN SCIENTIFIC NOTATION.
STATUS CODE

Figure 2-29. Measurement Data Output Format

the LCD display is updated. This avoids erroneously reading the last measurement if the measurement mode is changed.

NOTE

Whenever the first BYTE, of the status code (Table 2-8) is either "S" or "C," the measurement reading will be zero.

Table 2-8

Output Status Codes

2 BYTE Status Code (SC)	Meaning
GZ	GHz
VD	Volts - DC

Table 2-8 (Cont)

2 BYTE Status Code (SC)	Meaning
CW	CW - continuous wave
DB	dBm
IL	dB Insertion Loss
RL	dB return Loss
RO	RHo
VS	VSWR
MW	Milliwatts
S0	OK Send Data
S1	RAM Error
S2	ROM Error
S3	Over Range
S4	Under Range
S5	SYNTAX Error or Error in Sequence of Command
C1	Power Meter Calibration: "Disconnect RF Power"
C2	Power Meter Calibration: "Connect Device Under Test"
C4	Insertion Loss Calibration: "Connect Detector to J1"
C5	Insertion Loss Calibration: "Connect Load to J2"
C6	Insertion Loss Calibration: "Connect Device Under Test"
C8	Reflection Measurements Calibration: "Connect Detector to J2"
C9	Reflection Measurements Calibration: "Connect Short to J1"
C:	Reflection Measurements Calibration: Connect Open to J1"
C;	Reflection Measurements Calibration: "Connect Device Under Test"

2.19.7. Reading Data from the 7000A-02. Refer to Figures 2-30, 2-31 and 2-32 for examples of reading data from the 7000A-02 with various computers.

2.19.8. Device Control Messages. The 7000A-02 will respond to other messages issued by the controller to operate instruments on the bus. For specific information as to syntax and procedures to transmit these messages, refer to the operation manual for the controller being used. (See Figure 3-21 for a sample insertion loss measurement and calibration program written in basic for the Digital Equipment Corp. MINC-11.)

2.19.8.1. Remote Message: The 7000A-02 will go to remote control operation when the remote message is sent along with the 7000A-02 "listen" address. Remote operation is indicated by the "REM" indicator on the LCD. When this is on, the tune pot and the auto-step switches are controlled by the bus and all of the front panel push buttons are remotely programmable.

2.19.8.2. Local Message: The local message returns the 7000A-02 to local control. The instrument can also be returned to local control by pushing any front panel button.

2.19.8.3. Local Lockout Message: The local lockout message disables the front panel pushbuttons from returning control to local operation.

2.19.8.4. Clear Lockout and Local Message: The 7000A-02 will return to the local control mode after receiving this message.

2.19.8.5. Trigger Message: The trigger message causes the 7000A-02 to initiate a measurement cycle. The unit must be addressed to listen, to recognize this message. The measurement cycle initiated will be to restart the currently programmed function.

2.19.8.6. Abort Message: The abort message (Interface Clear) unconditionally returns control to the system controller and unaddresses all instruments.

2.19.9. External Printer Connection. The following set-up illustrated in Figure 2-32 will allow updated data that appears on the multimeter's LCD to be sent to the auxiliary pointer. To activate the multimeter's interface for an external printer, proceed as follows:

2.19.9.1. Remove the cover from the multimeter, observing procedure and the caution note under paragraph 4.2.1 through 4.2.1.2 in Section IV of this manual.

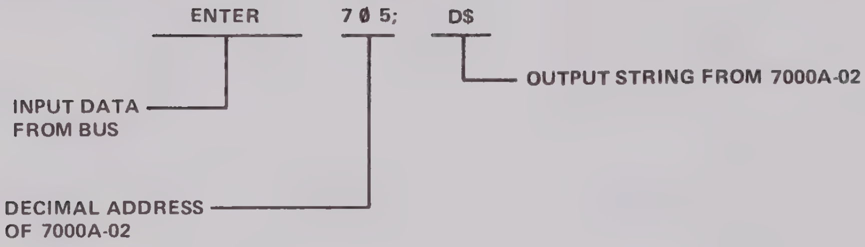

ENTER
7 0 5;
D$
OUTPUT STRING FROM 7000A-02
INPUT DATA FROM BUS
DECIMAL ADDRESS OF 7000A-02

Figure 2-30. Reading Data from 7000A-02 using HP-85

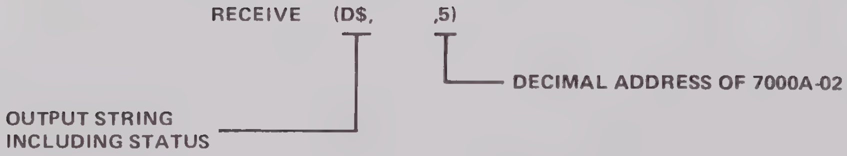

RECEIVE (D$, ,5)
DECIMAL ADDRESS OF 7000A-02
OUTPUT STRING INCLUDING STATUS

Figure 2-31. Reading Data from 7000A-02 Using Digital Equipment MINC-11

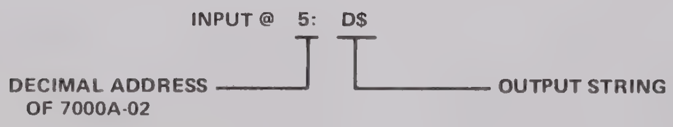

INPUT @ 5: D$
DECIMAL ADDRESS OF 7000A-02
OUTPUT STRING

Figure 2-32. Reading Data from 7000A-02 Using Tektronix 4051

```
6 IEEE_BUS_CLEAR
7 SET_TERMINATORS(10)
10 GO TO 10000
500 REM *****************************************************************
510 REM ***              SUBROUTINES                                  ***
1000 REM SUBROUTINE TO WAIT FOR CARRIAGE RETURN
1005 PRINT CHR$(7); \ A=SYS(1) \ IF A=13 THEN A=SYS(1) \ RETURN
1010 GO TO 1000
1099 REM ***                                                          ***
1100 REM SUBROUTINE TO PROGRAM 7000A/02 AT ADDRESS 5
1110 REM ENTER WITH M9$ = OUTPUT STRING
1120 M9$=M9$+CHR$(10)
1130 SEND(M9$,5)
1190 RETURN
1199 REM ***                                                          ***
1200 REM SUBROUTINE TO READ FROM 7000A/02 AT ADDRESS 5
1210 REM M8$ IS RECEIVED STRING
1220 RECEIVE(M8$,,5)
1299 RETURN
9000 REM ***               END SUBROUTINES                            ***
9010 REM ****************************************************************
10000 DISPLAY_CLEAR \ MOVE_CURSOR(1,1)
21010 PRINT '                     INSERTION LOSS DEMO
21012 PRINT 'ENTER START FREQUENCY FOR TEST '; \ INPUT F%
21014 M9$='FT'+STR$(F%) \ GOSUB 1100
21016 M9$='M40' \ GOSUB 1100
21017 PRINT 'ENTER STOP FREQUENCY FOR TEST '; \ INPUT F%
21018 M9$='FT'+STR$(F%) \ GOSUB 1100
21019 M9$='M40' \ GOSUB 1100
21020 M9$='M17'
21030 PRINT  \ PRINT  \ PRINT 'FOR AUTO STEP TYPE "A" '; \ INPUT A$
21040 IF A$='A' THEN M9$='M18'
21050 GOSUB 1100
21060 PRINT 'TYPE 12 OR 52 FOR NUMBER OF POINTS'; \ INPUT N
21070 IF N<>52 THEN N=12 \ M9$='M9'
21080 IF N=52 THEN M9$='M10'
21090 GOSUB 1100 \ REM  SET NUMBER OF POINTS
21100 M9$='M13' \ GOSUB 1100 \ REM  SET WAIT AFTER DISPLAY
21105 PRINT
21110 FOR I=1 TO N
21120 IF I=1 THEN M9$='M6' \ GOSUB 1100 \ REM  SET INS. LOSS
21130 IF I<>1 THEN M9$='M16' \ GOSUB 1100 \ REM CONTINUE
21140 GOSUB 1200 \ M1$=SEG$(M8$,16,17)
21150 IF M1$='IL' THEN 21230
21160 IF M1$='C4' THEN PRINT 'CONNECT DETECTOR TO J1 '; \ GOSUB 1000
21170 IF M1$='C5' THEN PRINT 'CONNECT 50 OHM LOAD TO J2 '; \ GOSUB 1000 \ GO TO 21190
21180 GO TO 21200
21190 PRINT  \ PRINT '            SYSTEM IS NOW BEING CALIBRATED !' \ PRINT
21200 IF M1$='C6' THEN PRINT 'CONNECT DEVICE UNDER TEST BETWEEN J1 AND DETECTOR  , \ GOSUB 1000
21210 PRINT
21220 GO TO 21110
21230 M8=VAL(SEG$(M8$,1,15))
21240 M9$='M32' \ GOSUB 1100
21250 GOSUB 1200
21260 M9=1000*VAL(SEG$(M8$,1,15))
21265 IF I=1 THEN PRINT  \ PRINT 'FREQ.-MHZ','DB INSERTION LOSS' \ PRINT
21270 PRINT M9,M8
21280 NEXT I
21290 PRINT 'ANOTHER RUN - Y/N '; \ INPUT A$
21300 IF A$='Y' THEN  GO TO 21020
21999 END
```

Figure 2-33. Insertion Loss Program in Basic for the DEC MINC-11

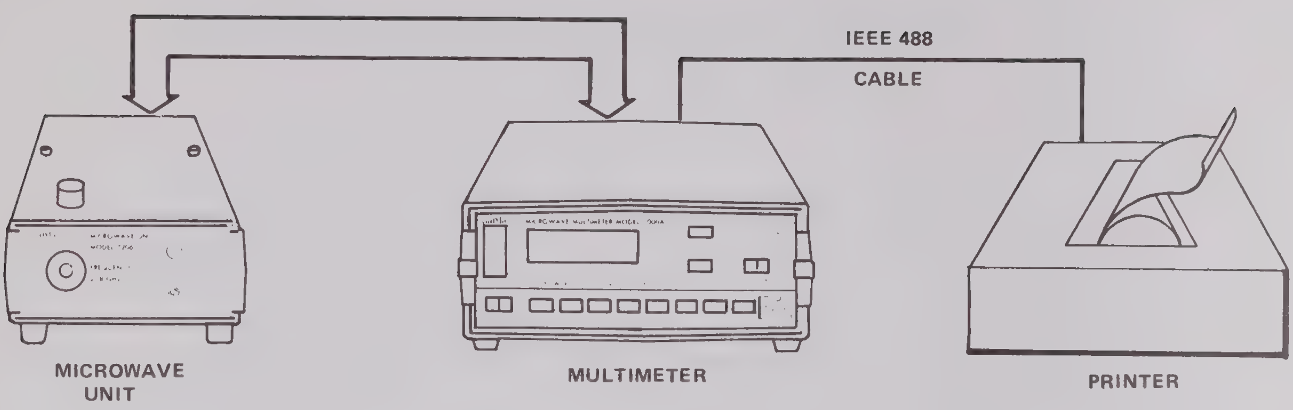


Figure 2-34. External Printer Connection

2.19.9.2. Go to the digital (A2) board located near the rear panel of the multimeter.

2.19.9.3. Set the address select switch S1 line 6 (located on the digital (A2) board)) to a "1" state (Reference Fig. 2-25). This activates the talk only mode for the IEEE-488 interface.

2.19.9.4. Reinstall the multimeter's cover.

2.19.9.5. Connect the printer with an IEEE-488 interface set for listen only, Narda Model 7500 to the IEEE-488 connector on the rear panel of 7000A-02 multimeter.

2.19.9.6. Leading zero's will be suppressed and a line will automatically be skipped preceding all auto-step sequences when using a 7000A-02 with serial number over 4000.

SECTION III

MICROWAVE MULTIMETER THEORY OF OPERATION
NARDA Model 7000A and 7000A-01

3.1. INTRODUCTION.

This section details the theory of operation for the Model 7000A and 7000A-01 (battery operated) microwave multimeter. There are two parts to this section. The first part, starting at paragraph 3.2, is a discussion of the operational flow of events that occur during various measurement modes. The second part, starting at paragraph 3.3. is a discussion of mismatch errors associated with a scalar system such as the 7000A/7105. Refer to Section IV of this manual for system block diagram and individual PC board block diagram information.

3.2. OPERATIONAL FLOW OF EVENTS.

The sequence of events that occur during power meter operations, insertion loss measurement, reflection measurement, signal generator operation and voltmeter operation are discussed separately in the following paragraphs:

3.2.1. Power Meter Operation. Refer to Figure 3-1 and note that when either dBm or μW mW is pressed, the multimeter first checks that it has zero (offset) voltages on all power ranges. If it does not, it will lead the operator through a zeroing procedure, adjust the zero bias (if required) and then store the zero (offset) voltages for all ranges in its memory. If zero (offset) voltages are already stored, the unit reads the voltage on the front panel "TUNE" Control and determines the corresponding frequency. Next, it looks up the calibration factor for that frequency. The unit then measures the amplified signal of the detector (V_{meas}), looks up for the gain for the range used (A_{range}) and makes corrections for the zero (offset) voltage and calibration factor (Volts out = A_{range} x (V_{meas} - zero (offset))/calibration factor). This value is compared to the data stored in the detector calibration prom and the corresponding power is determined (see Figure 3-2). This power level is then displayed and held on the LCD and the unit repeats the measurement and display cycle. Pressing FREQ DISP causes the unit to display the frequency of the calibration factor and rotating the "TUNE" control knob will update this frequency. Pressing dBm or μW mW

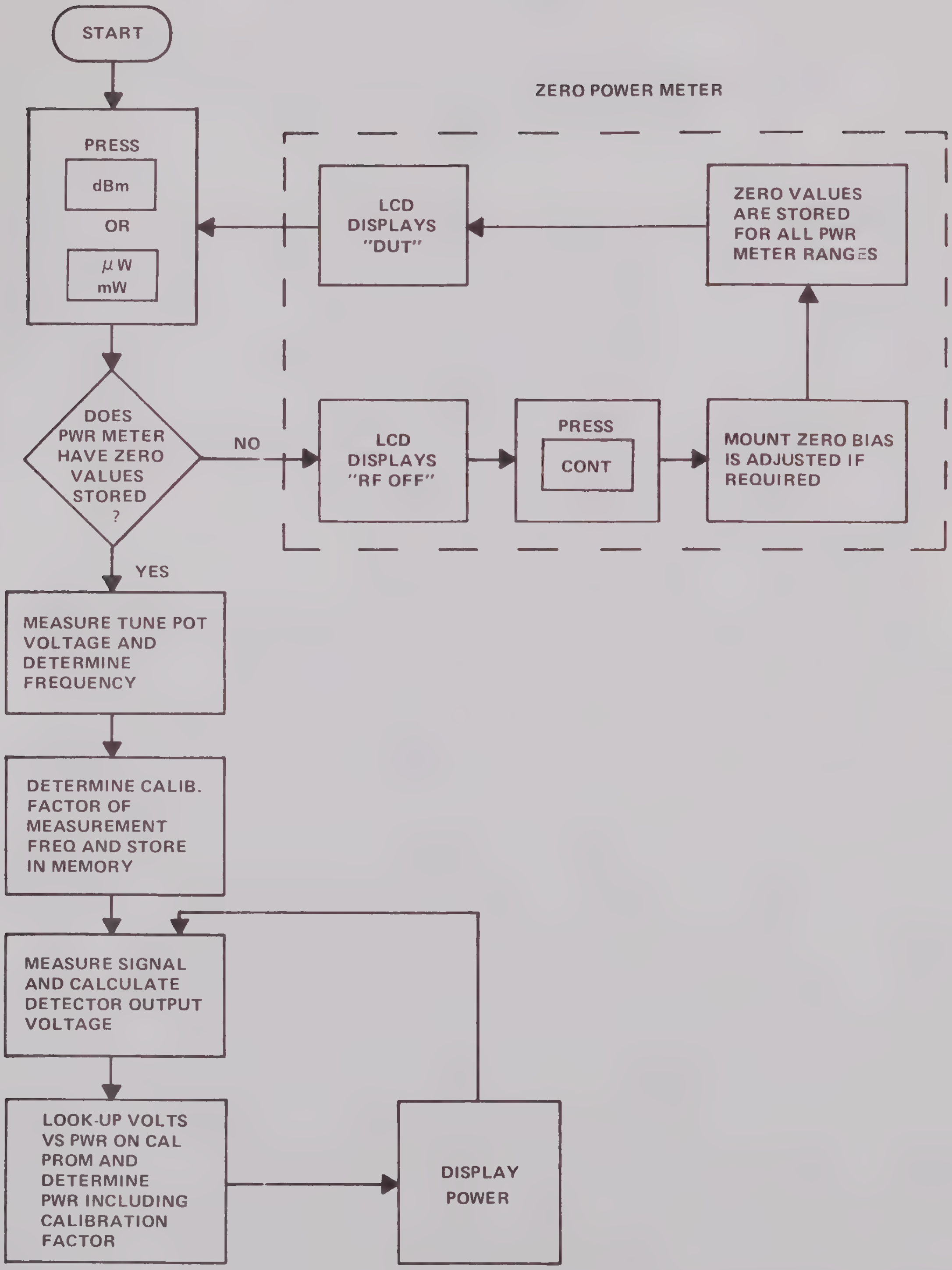

START
ZERO POWER METER
PRESS
dBm
OR
μW
mW
LCD DISPLAYS "DUT"
ZERO VALUES ARE STORED FOR ALL PWR METER RANGES
DOES PWR METER HAVE ZERO VALUES STORED ?
NO
LCD DISPLAYS "RF OFF"
PRESS
CONT
MOUNT ZERO BIAS IS ADJUSTED IF REQUIRED
YES
MEASURE TUNE POT VOLTAGE AND DETERMINE FREQUENCY
DETERMINE CALIB. FACTOR OF MEASUREMENT FREQ AND STORE IN MEMORY
MEASURE SIGNAL AND CALCULATE DETECTOR OUTPUT VOLTAGE
LOOK-UP VOLTS VS PWR ON CAL PROM AND DETERMINE PWR INCLUDING CALIBRATION FACTOR
DISPLAY POWER

Figure 3-1. Flow Diagram for Power Meter

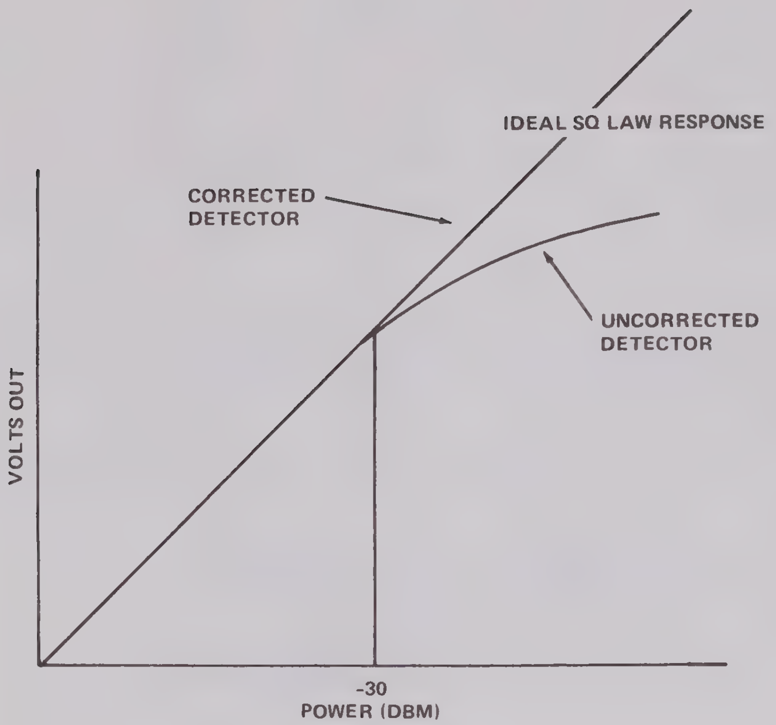


Figure 3-2. Detector Linearity

returns the instrument to continue making measurements. Turning the "TUNE" control knob will not update the calibration factor until dBm or µW mW is pressed.

3.2.2. Insertion Loss Measurement. Refer to Figure 3-3 and note that when INS LOSS is pressed the multimeter checks that it has calibration data for insertion loss in memory. If it does not, a calibration run is inititated which will zero the power meter in all ranges and then tune the oscillator across its band in 52 steps. At each frequency the power is read using the same technique described in the power meter section with one exception: instead of displaying the power, it is stored in memory. Fifty-one of the calibration points are evenly spaced across the band. The last point is set by the front panel "TUNE" control pot. See Figure 3-4 for a graphical presentation of the calibration points. After the calibration is complete, the LCD displays "dut." When CONT or INS LOSS is then pressed, the unit, (which now has calibration data), will start its measurement cycle either in "SINGLE FREQ" or "AUTO STEP." The oscillator is again tuned and the power is read. The multimeter compares the power levels and displays the difference in dB. Figure 3-5 graphically depicts the

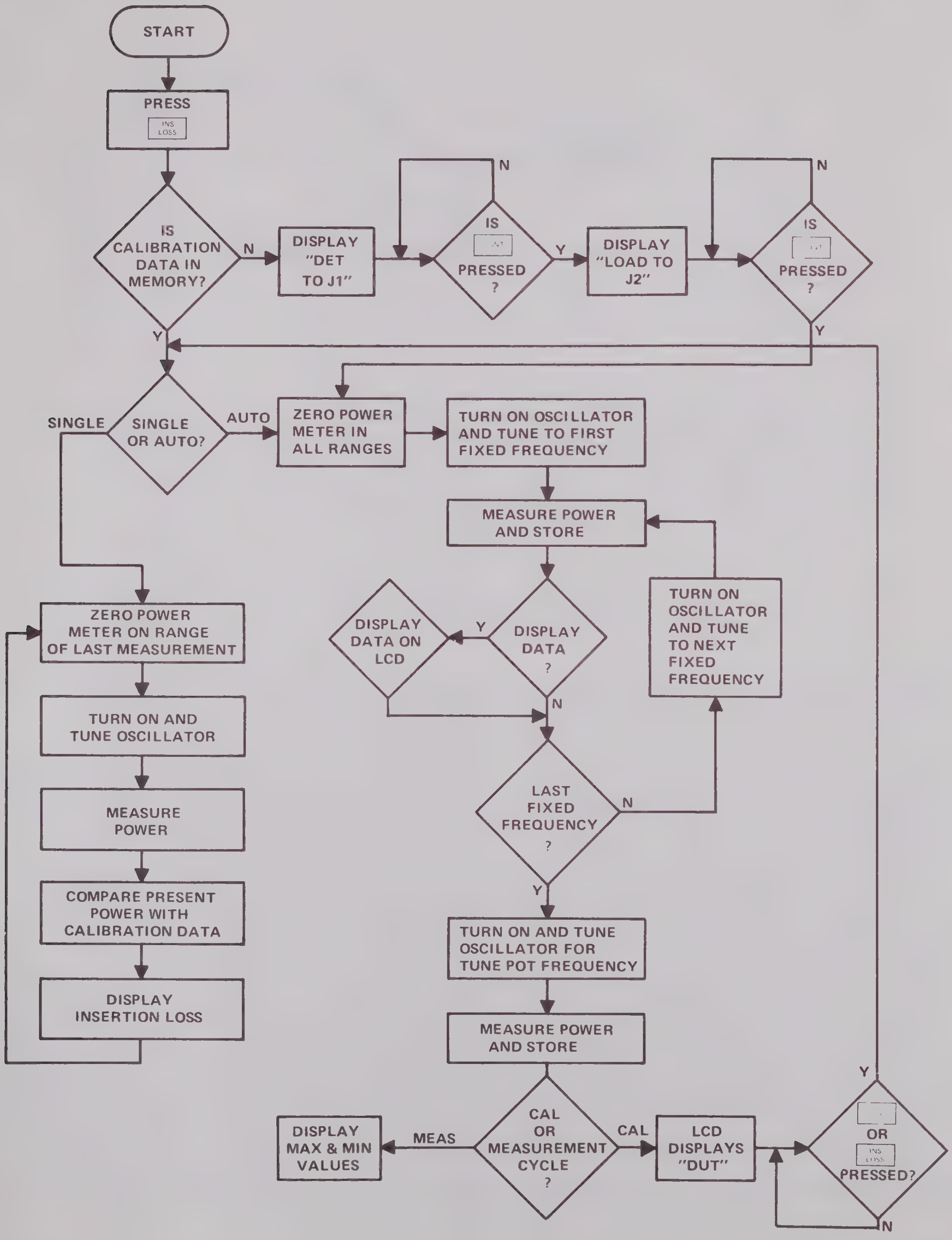

START
PRESS
INS LOSS
IS CALIBRATION DATA IN MEMORY?
N
Y
DISPLAY "DET TO J1"
IS
PRESSED ?
N
Y
DISPLAY "LOAD TO J2"
IS
PRESSED ?
N
Y
SINGLE OR AUTO?
SINGLE
AUTO
ZERO POWER METER IN ALL RANGES
TURN ON OSCILLATOR AND TUNE TO FIRST FIXED FREQUENCY
MEASURE POWER AND STORE
DISPLAY DATA ?
Y
N
DISPLAY DATA ON LCD
TURN ON OSCILLATOR AND TUNE TO NEXT FIXED FREQUENCY
LAST FIXED FREQUENCY ?
N
Y
TURN ON AND TUNE OSCILLATOR FOR TUNE POT FREQUENCY
MEASURE POWER AND STORE
CAL OR MEASUREMENT CYCLE ?
MEAS
CAL
DISPLAY MAX & MIN VALUES
LCD DISPLAYS "DUT"
OR
INS LOSS
PRESSED?
Y
N
ZERO POWER METER ON RANGE OF LAST MEASUREMENT
TURN ON AND TUNE OSCILLATOR
MEASURE POWER
COMPARE PRESENT POWER WITH CALIBRATION DATA
DISPLAY INSERTION LOSS

Figure 3-3. Insertion Loss Flow Diagram

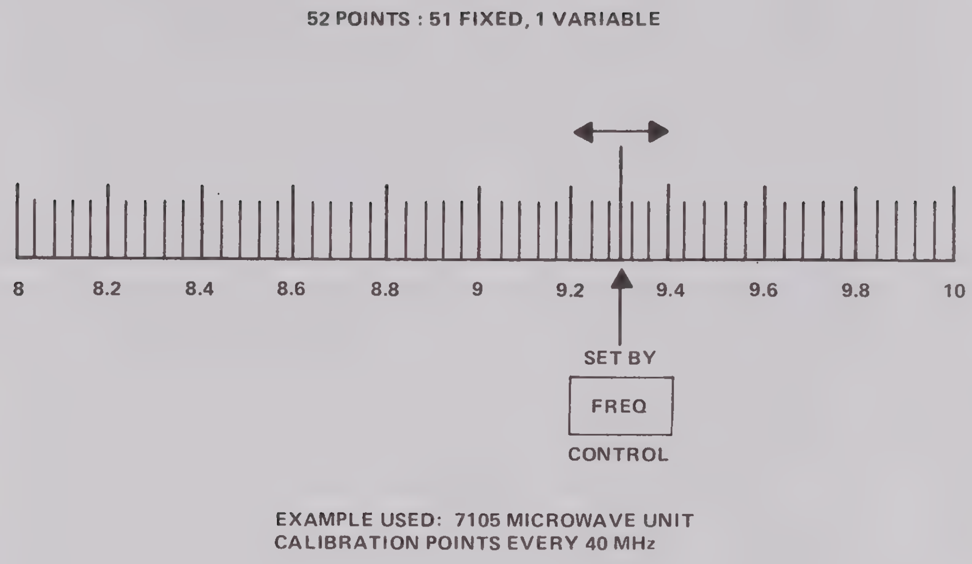

52 POINTS : 51 FIXED, 1 VARIABLE
8
8.2
8.4
8.6
8.8
9
9.2
9.4
9.6
9.8
10
SET BY
FREQ
CONTROL
EXAMPLE USED: 7105 MICROWAVE UNIT
CALIBRATION POINTS EVERY 40 MHz

Figure 3-4. Calibration Points, Insertion Loss and Reflection Measurements

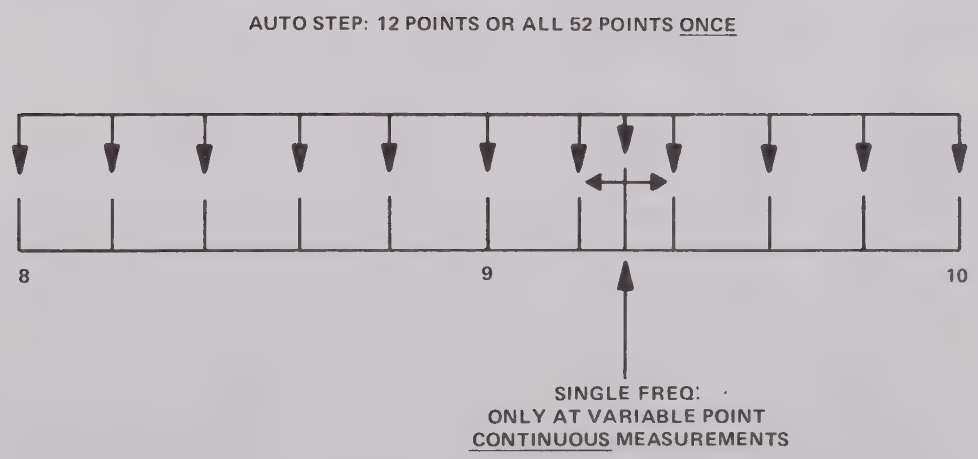

AUTO STEP: 12 POINTS OR ALL 52 POINTS ONCE
8
9
10
SINGLE FREQ:
ONLY AT VARIABLE POINT
CONTINUOUS MEASUREMENTS

Figure 3-5. Measurement Points Insertion Loss and Reflection Measurements

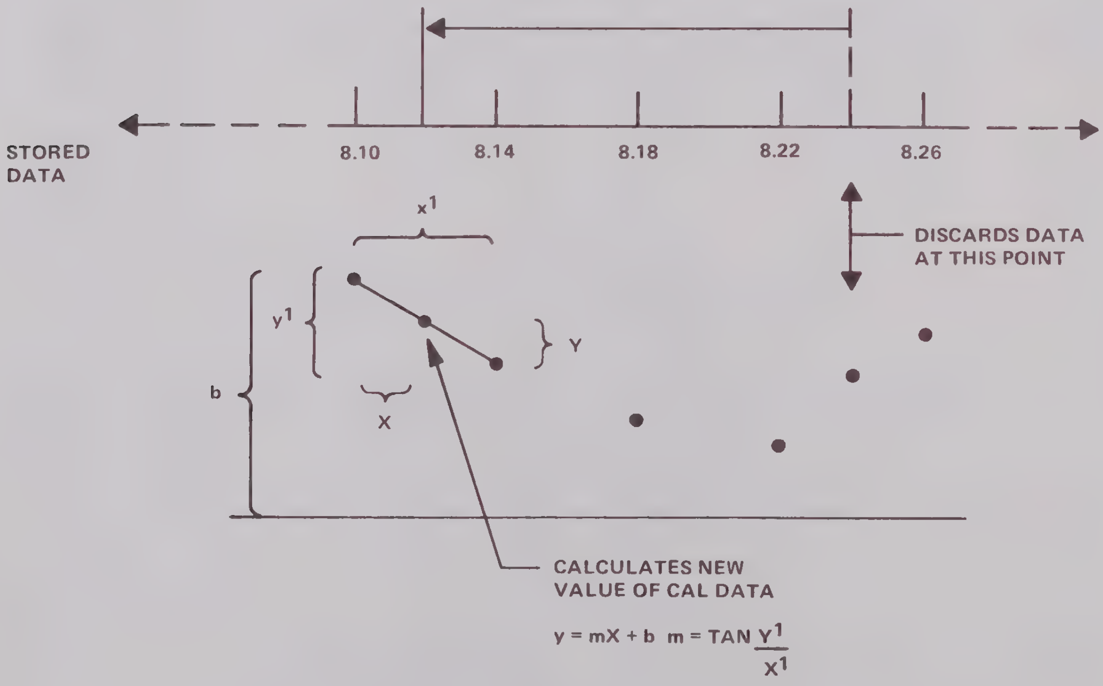
two measurement modes and Figure 3-6 describes the way the multimeter handles the movement of the selectable point from one frequency to another.

3.2.3. Reflection Measurements. Reflection measurements are made in much the same manner as insertion loss measurements. The microwave configuration is changed, so that reflected power instead of incident power is read, but the operational flow is similar (see Section II Operation). One exception is that in reflection measurements, two calibration runs are made, one with a short and one with an open on the test port. The average value of each calibration point in these two runs is stored in memory and is used as the 100% reflection power reference level. This procedure minimizes calibration errors caused by test point VSWR. The unit measures voltage and determines power by using a lookup table. When making reflection measurements, the following equations are used:

1. $\text{RHO} = \dfrac{\text{Reflected Voltage}}{\text{Incident Voltage}}$

2. $\text{VSWR} = \dfrac{1 + \text{RHO}}{1 - \text{RHO}}$

3. $\text{RTN Loss} = 20 \text{ Log RHO}$


STORED DATA
8.10
8.14
8.18
8.22
8.26
DISCARDS DATA AT THIS POINT
x^1
y^1
Y
b
X
CALCULATES NEW VALUE OF CAL DATA
$y = mX + b \quad m = \text{TAN} \dfrac{Y^1}{X^1}$

EXAMPLE:

USING 7105 MICROWAVE UNIT, MOVE VARIABLE POINT AFTER CALIBRATION. THE MULTIMETER CALCULATES CALIBRATION DATA AT THE NEW POINT.

Figure 3-6. Moving the Variable Measurement Point

Changing the mode from RTN LOSS to VSWR or RHO or any other combination of the three only changes the final equation used in processing the data.

3.2.4. Signal Generator Operation. Refer to Figure 3-7. When 2nd and SIG GEN is pressed, the oscillator in the microwave unit is turned on and the tuning voltage comes directly from the tune pot. The voltage on the tune pot is measured and used to calculate the output frequency of the oscillator by using a look-up table of frequency vs. voltage in a calibration prom in the microwave unit. This frequency is then displayed on the LCD and the tuning voltage is read again. For microwave units requiring an external source, turning on the oscillator corresponds to turning on a PIN switch in the microwave path. (See Section II: Operation.)

3.2.5. Sweep Generator Operation. When 2nd and SWEEP GEN is pressed the microprocessor develops two ramps through the D/A converters. One is used for tuning the input for the microwave oscillator. The other one is sent to the "SWEEP OUT" connector on the rear panel of the multimeter. This voltage is used to externally sweep an oscilloscope. The ramp to the microwave unit's frequency source is linearized using the data from the "CAL" prom in the microwave unit.

3.2.6. Voltmeter Operation. Refer to Figure 3-8 and note that when VDC is pressed, the multimeter reads the voltage on the VDC high probe. If the voltage is not in range, it changes the range up or down and measures again. The unit will also change polarity, if required. Once the voltage read on the VDC high probe is in range, the voltage read, along with its polarity, is stored in memory. Next, the VDC low probe is measured using the same technique. The two voltages are subtracted (VDC Hi-VDC Lo) and displayed on the LCD. This process is repeated continuously.

3.2.6.1. Voltmeter Ground. To avoid a dangerous condition, the multimeter does not have a floating ground, which would cause the microwave detector to assume the voltage of the VDC "LO" lead. Instead, the voltage on each lead is measured relative to a reference ground and digitally subtracted. It is important therefore, that the multimeter be grounded to the ground of the device being measured.

3.3. MISMATCH ERROR.

The total accuracy of a measurement is the combination of instrument accuracy plus measurement uncertainty. Errors or uncertainties are introduced with the measurement or calibration of equipment because of the mismatch of devices when connected together. These mismatches are present because any device being

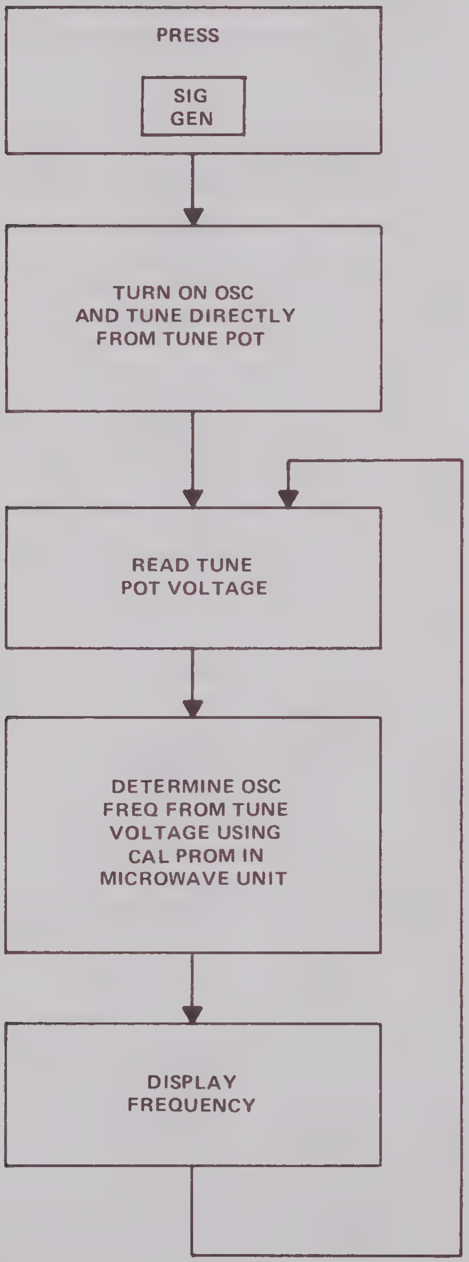

PRESS
SIG GEN
TURN ON OSC AND TUNE DIRECTLY FROM TUNE POT
READ TUNE POT VOLTAGE
DETERMINE OSC FREQ FROM TUNE VOLTAGE USING CAL PROM IN MICROWAVE UNIT
DISPLAY FREQUENCY

Figure 3-7. Signal Generator Operation Flow Diagram

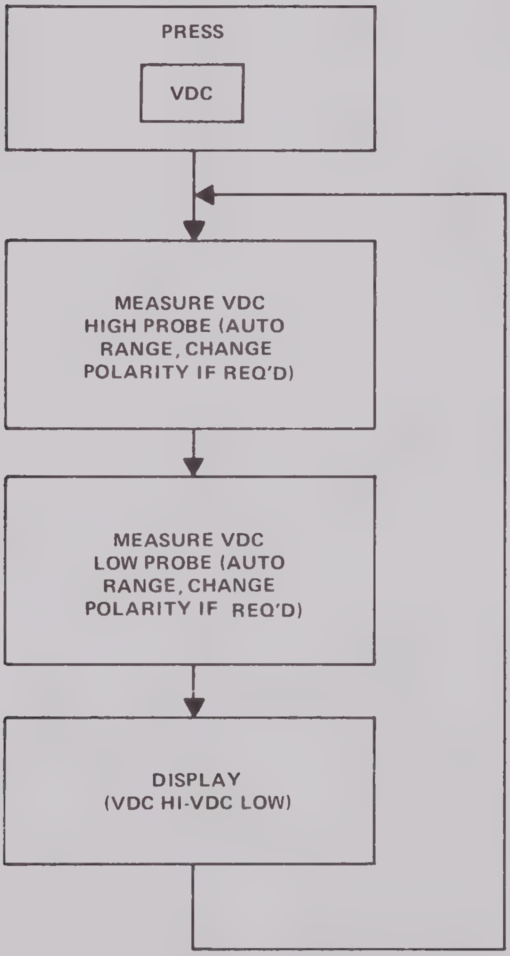

PRESS
VDC
MEASURE VDC HIGH PROBE (AUTO RANGE, CHANGE POLARITY IF REQ'D)
MEASURE VDC LOW PROBE (AUTO RANGE, CHANGE POLARITY IF REQ'D)
DISPLAY (VDC HI-VDC LOW)

Figure 3-8. Voltmeter Operation Flow Diagram

measured or any device performing the measurement is not an ideal 50 ohm impedance. Therefore, mating together various devices, each with an imperfect VSWR or "mismatch," causes an uncertainty. The uncertainty results because the mismatch of a device prevents it from absorbing all the power incident upon it. These uncertainties exist for power, insertion loss or reflection measurements and are described in detail under paragraphs 3.3.1, 3.3.2 and 3.3.3.

3.3.1 Power Meter Mismatch Uncertainty. Refer to Figure 3-9. The mismatch uncertainty of this set-up in dB, is:

$$M\mu_{dB} = 20 \log (1 \pm \rho_g \rho_D)$$

where: $M\mu$ = mismatch uncertainty (maximum) in dB.

ρ_g = Generator Reflection coefficient, RHO.

ρ_D = Load (Detector) Reflection coefficient, RHO.

For the detectors used in the Narda 7100 and 7200 series microwave units, this equation yields the following worst case measurement uncertainties:

$VSWR_g$	ρ_g	Freq $\leq$ 4 GHz ($\rho_D = 0.091$)	Freq 18 GHz $\leq$ 4 GHz ($\rho_D = 0.167$)
1.10:1	.048	±.04 db	±.07 db
1.20:1	.091	±.07 db	±.13 db
1.50:1	.200	±.15 db	±.30 db
2.00:1	.333	±.26 db	±.50 db

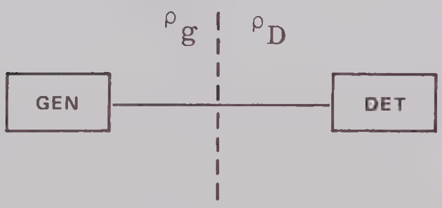


Figure 3-9. Power Meter Measurement Mismatch Uncertainty

3.3.2. Reflection Measurement Uncertainty. A typical reflection measurement set-up is shown in Figure 3-10. The measurement uncertainty of this set-up, in terms of a measurement of reflection coefficient, RHO, is:

$$M_\mu = d \pm \left[\frac{\rho_g T_1 T_2 + \rho_1}{1 - \rho_g \rho_2}\right] \rho_L^2$$

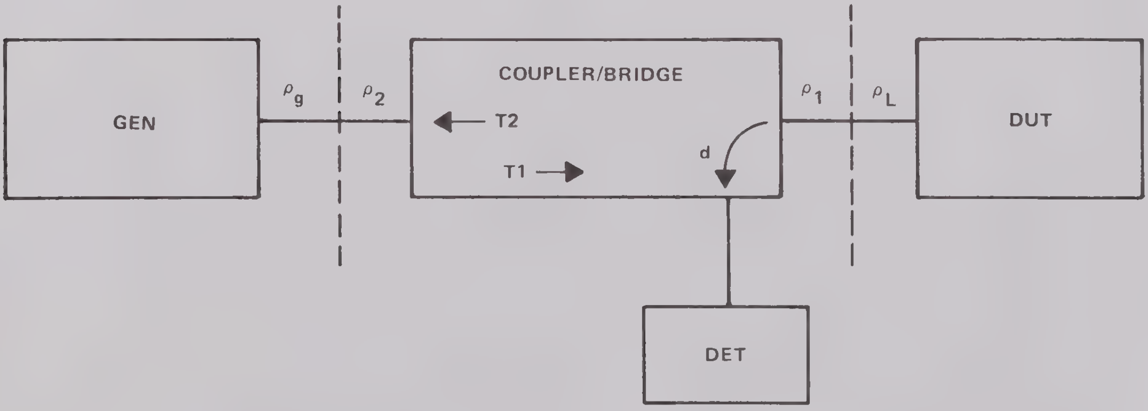
For example, catalog component specs for this set-up would read as follows:

Signal generator assuming no cabling contribution:

Signal Generator VSWR = 2.0 $\rho_g = .33$
Coupler I.L. = 0.5 dB $T_1 = T_2 = .944$
VSWR in = 1.2 $\rho_2 = .091$
out = 1.2 $\rho_1 = .091$
Directivity = 35 dB, $d = .018$

then $$M_u = .018 \pm \left[\frac{.33\,(.994)^2 + .091}{1 - .33\,(.091)}\right] \rho_L^2$$

$$M_u = \pm.018 \pm 0.43\,\rho_L^2 \qquad (A)$$



$T_{1\&2}$ ≡ Through transmission of coupler/bridge $= 10^{\left(\frac{-\text{Ins. Loss In dB}}{20}\right)}$

d ≡ Directivity of coupler/bridge $= 10^{\left(\frac{-\text{Directivity In dB}}{20}\right)}$

DUT ≡ Device under test

Figure 3-10. Typical Reflection Measurement Uncertainty

3.3.2.1 It can be shown that the signal generator impedance causes a very significant part of the above uncertainty for measurements of high reflection coefficient and the directivity of the coupler is most significant for low values of reflection coefficient.

3.3.2.2 By comparison to the above example, the Narda Model 7105, 8-10 GHz microwave unit, integrates the signal generator with the measurement coupler and tunes out the majority of errors. The total source VSWR, including couplers and cables in 1.15:1 with a worst case directivity of 40dB. Equation "A" becomes:

$$M_\mu = \pm .010 \pm .07 \rho_L^2 \qquad (B)$$

for the Model 7105. A quick comparison of the errors associated with a standard set-up (Equation "A") and the Narda 7105 (Equation "B") is given below:

ρ Actual	Standard Measurement Uncertainty	Narda 7105 Uncertainty	Actual Return Loss	Standard Measurement Uncertainty	Narda 7105 Uncertainty
.05	±.019	±.0102	-26dB	-2.78dB +4.17dB	-1.60dB +2.01dB
.1	±.022	±0107	-20dB	±1.73dB	±.98dB
.3	±.054	±.0163	-10.5dB	±1.5dB	±.50dB

3.3.3. Transmission (Insertion Loss/Gain) Mismatch Uncertainty. A similar analysis can be done for transmission measurements. When the system is calibrated, there is a mismatch error in the calibration measurement. Figure 3-11 shows this set-up. When the device under test is inserted, there are mismatch errors at both interfaces, as shown in Figure 3-12. The total error equation for this, including calibration is:

$$M_\mu = 20 \log \left[\frac{(1 \pm \rho_g \rho_D)}{(1 \pm \rho_g \rho_3)(1 \pm \rho_4 \rho_D) \pm \rho_g \, T1 \, T2 \, \rho_D} \right]$$

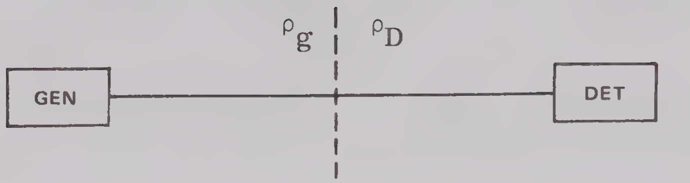


Figure 3-11. Mismatch Error for Insertion Loss Measurements: Calibration Setup (No device under test)

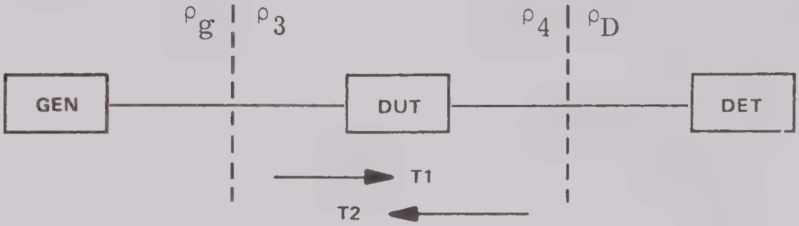


Figure 3-12. Mismatch Error for Insertion Loss Measurement Set-up (Including device under test)

In determining the accuracy of the measurement, it is essential to know the reflection coefficients of all components involved. The mismatch uncertainty for transmission measurements using Model 7105 specifications can be reduced to the following:

$$M_\mu = 20 \log \left[\frac{1 \pm .0085}{(1 \pm .05\rho_3)\ (1 \pm .17\rho_4)\ \ \pm .0085\ \ T_1\ T_2} \right]$$

where: $\rho_3 \equiv$ input reflection coef. of device under test

$\rho_4 \equiv$ output reflection coef. of device under test

$$T \equiv 10^{\left(\frac{-\text{Ins Loss (dB)}}{20}\right)}$$

$T_1 \equiv$ forward transmission ratio of device under test

$T_2 \equiv$ reverse transmission ratio of device under test

Examples:

Attenuator Insertion Loss	Attenuator VSWR (Both Ports)	M_{μ} (db)
10	1.1	±.17
10	1.2	±.25
6	1.2	±.25
3	1.2	±.28

SECTION IV

MICROWAVE MULTIMETER MAINTENANCE
NARDA Model 7000A and 7000A-01

4.1. INTRODUCTION.

Before starting maintenance, perform the "Interconnect and Turn-on Procedures" described under paragraph 2.8 in Section II of this manual and check Table 4-1 for a list of required test equipment. Table 4-3 summarizes maintenance adjustments. If additional schematic or parts location information is needed for maintenance purposes, refer to Section VI of this manual. It is suggested that the microwave unit and the multimeter be calibrated together to save time.

4.2. FUNCTIONAL AND ACCURACY TESTS AND ADJUSTMENTS.

The multimeter that passes all functional and accuracy checks is fully operational to original manufacturer's specifications and may be returned to service. Adjustments describe the procedure for aligning a unit that passes functional tests but does not meet accuracy specifications. These tests will systematically test one or several functional blocks of the multimeter at a time while adding a minimum number of new functional blocks with each new test. The tests were designed this way to tie in directly to the troubleshooting procedure. A troubleshooting chart reference will be given at the beginning of each test for reference, should the adjustment not bring the unit into the specified calibration limits. Before going to the referenced troubleshooting chart, read paragraph 4.5, Troubleshooting and paragraph 4.6, Using the Troubleshooting Chart. To perform functional and accuracy tests and adjustments, proceed as follows:

Table 4-1

Required Test Equipment

ITEM NO.	DESCRIPTION
1 or 1A	7100, 7300 or 7400 Series microwave unit with internal source. 7200 Series microwave unit without internal source, and an external source with the required 2 BNC and 1 RF interconnect cables.

Table 4-1

Required Test Equipment

ITEM NO.	DESCRIPTION
2	37 PIN Interconnect cable NARDA P/N 319067 supplied with the multimeter.
3	4 1/2 digit DVM, RMS responding. Data Precision 2480R or equivalent.
4	DC Power Supply, 0-20V or voltage calibrator.
5	DC Power Supply, 0-200V or voltage calibrator.
6	Oscilloscope, with external sweep input capability. TEK 454 or equivalent.
7	Frequency Counter. 5Hz - 18 GHz, EIP 351 or equivalent.
8	Crystal Detector. Narda Model 503 or equivalent.
9	Two BNC cables four feet long. Narda Model SBNCB-48.
10	Source, + 10.0 mW ± .10 mW, 50 or 100 MHz.
or	
10A	Source + 1.0 mW ± .01 mW, 50 or 100 MHz.
11	RF Source, Power out ≥ 100 mW, 50 or 100 MHZ HP8601 or equivalent.
12	Step Attenuator, 0 - 90 dB in 10 dB steps. HP 355D option 001, or equivalent.
13	Step Attenuator, 0 - 9 dB in 1 dB steps. HP355C option 001, or equivalent.

4.2.1. Preliminary Instructions. Following interconnect procedures outlined in paragraph 2.8 through 2.8.3 in Section II of this manual and before turning on the power switch, remove the top cover of the multimeter by the following procedure:

CAUTION

STATIC SENSITIVE DEVICES

CMOS devices have been used extensively in the multimeter. Standard anti-static procedures should therefore be employed whenever the unit is opened.

4.2.1.1. Remove the four phillips head screws from the feet located on the bottom surface of the multimeter.

4.2.1.2. Press down on the upper surface of the side bezel while carefully prying the top from the body, to avoid complete disassembly of the multimeter case.

4.2.1.3. Mechanical Zero Adjustment. With the power off, note that the pointer of the front panel analog meter is in line with the bottom scale marker. Ref. Figure 6-8.

4.2.1.4. To align the pointer, use the adjustment lever that is located on back of the analog meter. Replace the meter if this cannot be done.

4.2.1.5. Set power switch to "ON" position. Over a period of approximately five seconds the LCD readout will display all segments illuminated as shown in Figure 2-7, Section II of this manual, followed by a brief display of the minimum and then maximum rated frequency points of the microwave unit being used*. During this time, the multimeter performs an internal self-test of the microprocessor, internal memories and program integrity. After these internal tests have been completed, the LCD readout will indicate that the multimeter is in the Volts mode. The LCD readout will display 0.000 plus or minus .003 volts. For units equipped with GPIB (option-02) the "REM" annunciator will be off. For units without the GPIB option the "REM" annunicator could be either on or off at this time depending on date of manufacture. If the "REM" annunciator is on, pressing the VDC pushbutton will cause it to go off.

4.2.1.6. If the multimeter does not turn on, check the line voltage and fuse as outlined under paragraph 2.5 in Section II of this manual.

4.2.1.7. There are no adjustments on the LCD. For corrective action, refer to the troubleshooting chart for self-check turn on procedure (Figure 4-16-1). Before using the troubleshooting chart, read paragraphs 4.5 and 4.6.

4.2.2. Front Panel Controls Test. After completing all steps listed under paragraph 4.2.1 perform the following tests to verify proper operation of the front panel controls:

4.2.2.1. Turn the "TUNE" control knob fully counterclockwise.

4.2.2.2. Press the "SINGLE FREQ"/"AUTO STEP" switch to "AUTO STEP".

4.2.2.3. Operate the controls in the order given in Table 4-2. The correct LCD readout and annunciator display is listed next to the Control Operation column.

4.2.3. Voltmeter Test. After completing the front panel controls test perform the following test to verify accuracy of the voltmeter's DVM.

*When using a 7000A-02 the bus address will be momentarily displayed after the maximum rated frequency.

Table 4-2

Front Panel Control Test

STEP NO.	CONTROL OPERATION	LCD READOUT	ANNUNCIATOR
1	Turn power on and switch to "AUTO STEP"	Multimeter goes through self adjust, final reading is .000 (±.003)	VOLTS
2	Press RTN LOSS	"dEt", "to", "J2"	RTN LOSS
3	Press VSWR	"SH", "to", "J1"	VSWR
4	Press dBm	"rF", "oFF"	(none)
5	Press RHO	"dEt", "to", "J2"	RHO
6	Press CONT	"SH", "to", "J1"	RHO
7	Press INS LOSS	"dEt", "to", "J1"	INS LOSS
8	Switch to "SINGLE FREQ"	"load", "to", "J2"	INS LOSS
9	Press VDC	".000" (±.003)	VOLTS
10	Press 2nd	"2nd"	VOLTS
11	Press 12 PTS	(readout is blank)	VOLTS
12	Press µW mW	"rF", "oFF"	(none)
13	Press VDC	".000" (±.003)	VOLTS
14	Press and Hold "PUSH FOR CW"	".000" (±.003)	CW
15	Release "PUSH FOR CW"	".000" (±.003)	VOLTS
16	Turn "TUNE control knob full counter-clockwise	".000" (±.003)	VOLTS
17	Press VSWR then dBm and then FREQ DISP	".000" (to .050)	GHz

Table 4-2 (Cont)

STEP NO.	CONTROL OPERATION	LCD READOUT	ANNUNCIATOR
18	Slowly rotate "TUNE" control knob to full clockwise while watching LCD readout and Analog meter	(LCD numerical display increases to a number > 18.0. The analog meter indication rises smoothly until the LCD reads approximately 4.0 GHz, then drops to near min. then smoothly rises again.)	GHz

NOTE

There are no adjustments for front panel controls. For corrective action refer to paragraph 4.5, troubleshooting, then to Figure 4-16-2.

NOTE

When checking a battery operated multimeter (Narda Model 7000A-01) connect the rear panel ground terminal of 7000A-01 to the power supply chassis.

4.2.3.1. Press VDC and set the power supply for 19.00 Volts as read on the reference DVM in Figure 4-1.

4.2.3.2. The multimeter should read 19.00 volts ± 0.10 volts. (Refer to Figure 6-5 in Section VI of this manual and) adjust A3 R47 (D/A Gain) as required for compliance. (Troubleshooting ref. Figure 4-16-3 (START)).

4.2.3.3. Reverse the inputs to the multimeter. The multimeter should now read -19 Volts ± 0.10 volts and should be within .04 volts of the magnitude read for the positive voltage on the HI lead. Adjust A3 R23 (VM Balance) as required for compliance. (Troubleshooting ref. Figure 4-16-3 Ⓐ)

4.2.3.4. Reverse the polarity of the power supply so that it delivers -19.00V as shown on the reference DVM and connect the equipment as shown in Figure 4-2. The

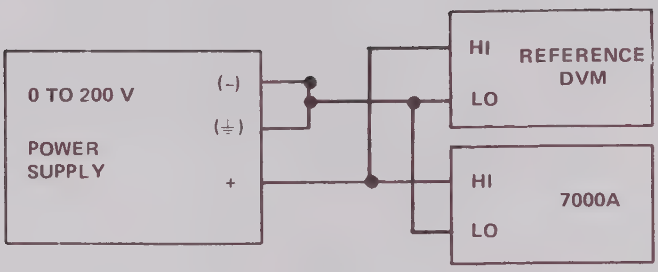

0 TO 200 V
POWER
SUPPLY
(-)
(⏚)
+
HI
LO
REFERENCE
DVM
HI
LO
7000A

Figure 4-1. Voltmeter Test Positive Voltage Gain and Hi/Lo Input Balance

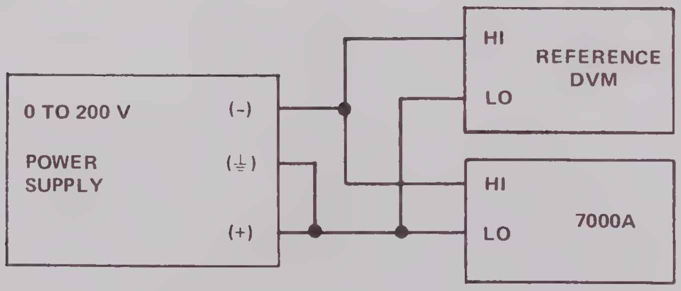

0 TO 200 V
POWER
SUPPLY
(-)
(⏚)
(+)
HI
LO
REFERENCE
DVM
HI
LO
7000A

Figure 4-2. Voltmeter Test Negative Voltage Gain

multimeter should now read -19 volts ± 0.10 volts. (Troubleshooting ref., Figure 4-16-3Ⓑ).

4.2.3.5. Reverse the multimeter's leads. The multimeter should now read + 19.00 volts ± 0.10 volts. (Troubleshooting ref., Figure 4-16-3Ⓒ).

4.2.3.6. Readjust A3 R37 (D/A Gain) so that the magnitude of difference obtained shown in paragraphs 4.2.3.2 and 4.2.3.5 is evenly divided.

4.2.3.7. Connect the equipment as shown in Figure 4-3.

4.2.3.8. Set one power supply for +3.00V and the other for -3.00V, as shown in Figure 4-3. The multimeter should now read +6.00 volts ±.02 volts. Adjust A3 R37 (Sync Det. Offset) for compliance. (Troubleshooting Figure 4-16-3Ⓒ.)

4.2.3.9. Reverse the leads on the multimeter. The display should now be -6.00 volts ±.02 volts. This reading should be within .02 volts of the magnitude of the voltage read in paragraph 4.2.3.8. Readjust A3 R37 (Sync Det. Offset) for compliance. (Troubleshooting ref., Figure 4-16-3Ⓒ).

4.2.3.10. Repeat steps 4.2.3.8 and 4.2.3.9 until the magnitude of the displayed voltage is constant. Then return to step 4.2.3.1 and perform the same test again, making adjustments as required.

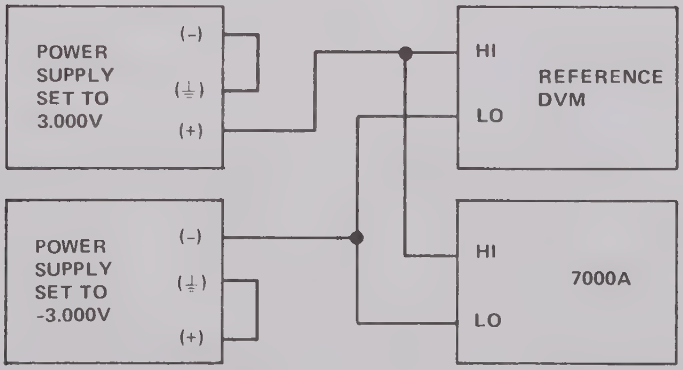


Figure 4-3. Voltmeter Test Offset Null

4.2.3.11. To test for ±190 volts and tracking, set up the equipment as shown in Figure 4-1. Set the power supply voltage to 190 volts. The multimeter should read 190.0 volts ±1.0 volts. Adjust A3R53 (x.01 gain) for compliance.

4.2.3.11.1. Vary the voltage from 0 to 199V, selecting an equal number of points in the 0 to 1.99V, 1.991 to 19.9V, and 19.91V to 199V ranges and compare the reference DVM and the multimeter. All readings should be within ±0.5% of the full scale voltage for the range used. The full scale voltages are: 1.99 Volts, 19.9 Volts and 199 Volts.

4.2.3.11.2. Repeat paragraph 4.2.3.11.1 for the Lo input of the multimeter. If the multimeter is not within ±.5% of full range, refer to the troubleshooting chart, Figure 4-16-3Ⓓ.

4.2.4. Power Meter Test. After completing the voltmeter test perform the following test to verify accuracy of the power meter section. (Troubleshooting ref., Figure 4-16-4).

NOTE

This test checks the accuracy of both the 7000A multimeter and the microwave unit, combining both accuracies under the heading of 7000A microwave multimeter accuracy.

4.2.4.1. Connect the equipment as shown in Figure 4-4.

4.2.4.2. Turn the reference power source off.

4.2.4.3. Press µW mW then 2nd and CALIB on the multimeter to select the power meter mode. Press CONT to cause the multimeter to auto zero.

4.2.4.4. Turn the "TUNE" pot on the front panel of the multimeter fully counterclockwise and press FREQ DISP followed by µW mW to select the lowest frequency calibration factor (50 MHz).

4.2.4.5. Turn the reference power source on.

4.2.4.6. Adjust the calibration pot (CAL) on the front panel of the microwave unit until the correct input power is read on the multimeter's LCD. This adjustment should be a maximum of 2 to 3% change.

4.2.4.7. 220 Hz Clock Adjustment. When making adjustments on the A2 (digital) board refer to figure 6-3, located in Section VI of this manual, and proceed as follows:

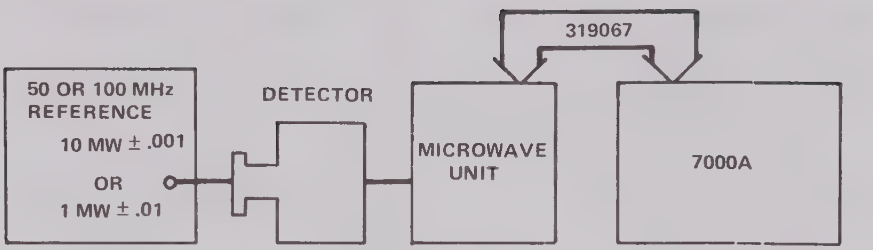


Figure 4-4. Power Meter Calibration/Gain Test

4.2.4.7.1. Jumper A2 TP2 (NMI) to A2 TP3 (+5V). This will cause the unit to go into a steady state. The LDC will no longer be updated with new data.

NOTE

> To access A2 TP2 and A2 TP3 in multimeters (with serial numbers under 03000) battery (-01) option, the power supply board (A4) will have to be dismounted. Turn power off and remove the four phillips head screws at the corners of the board. Move the PC board to one side and place insulating material below it. Refer to Figure 6-2 in Section VI of this manual for (A4) power supply board information. On newer units these test points are easily accessable without removing the power supply PC board.

4.2.4.7.2. Using a high impedance scope probe (> 1 megohm) connect A2 TP4 (U29 Pin 1) to a counter. The frequency read should be 220 Hz ±2 Hz. Adjust A2 R12 (frequency adjustment) for compliance.

4.2.4.7.3. Remove the jumper between A2TP2 and A2TP3.

4.2.4.8. Normalizing Gain between Microwave Multimeters. For labs having more than one microwave multimeter, their gains may be normalized by the following procedures:

4.2.4.8.1. Select one multimeter to be the standard.

4.2.4.8.2. Calibrate a microwave unit as shown in steps 4.2.4.1 through 4.2.4.5.

4.2.4.8.3. Connect the calibrated microwave unit to the multimeter that is to be calibrated. Then repeat steps 4.2.4.1 through 4.2.4.5.

4.2.4.8.4. Turn the reference power source on. Then adjust A3 R7 (Power Meter Calibration) until the correct power is read on the multimeter's LCD.

NOTE

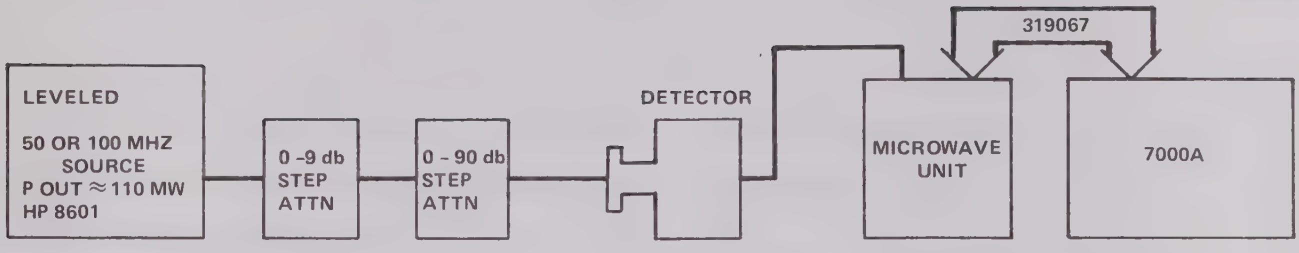
> The calibration adjustment pot (CAL) on the microwave unit and the cal pot on A3 R7 are in series with one another. The only advantage in setting the multimeters to a standard gain is that various microwave units may then be interchanged among the multimeters without needing readjustment or recheck of the system gain.

4.2.4.9. Power Meter Linearity Test. Connect the equipment as shown in Figure 4-5 or 4-5A and proceed as follows:

4.2.4.9.1. Press [dBm], then press [2nd] and [CALIB]. Follow calibration instructions.

4.2.4.9.2. Set the 10 dB step attenuator to 10 db and adjust the signal source for 10.00 dBm, as read on the multimeter's LCD.

4.2.4.9.3. Use both step attenuators to set values in 2 dB steps, from 10 dB to 70 dB and note that the multimeter reads the computed power levels to within the test set up and multimeter accuracies. Refer to 4.2.4.9.4 for Total Uncertainty computation. The accuracy specification for the multimeter with a calibrated microwave unit is ±3% or ±.15 dB (assuming 0% calibration factor error). The total accuracy of the entire test setup as shown in Figure 4-5 is ±.72 dB including step attenuator accuracy.


LEVELED
50 OR 100 MHZ SOURCE
P OUT ≈ 110 MW
HP 8601
0 -9 db STEP ATTN
0 - 90 db STEP ATTN
DETECTOR
319067
MICROWAVE UNIT
7000A

CONTROL SETTINGS:

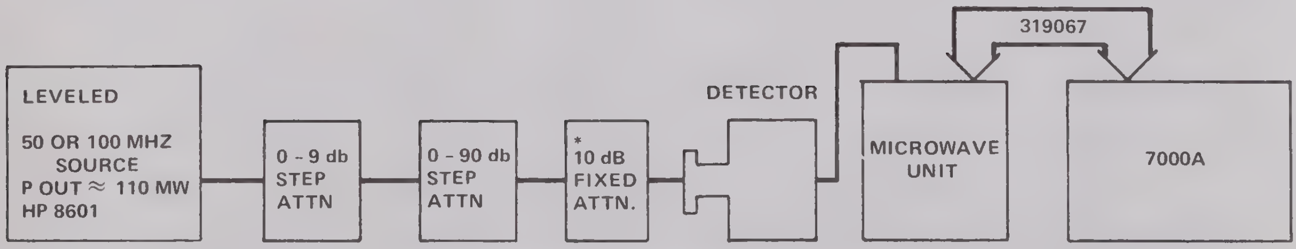
SOURCE: FREQ: 50 OR 100 MHZ
POWER OUT: ≈ 110 MW
LEVELING: SOURCE MUST BE LEVELED

ATTENUATORS: 0 - 9 db : 0 db
0 - 90 db : 90 db

7000A:

SEE TEXT

Figure 4-5. Power Meter Linearity Test


LEVELED
50 OR 100 MHZ SOURCE
P OUT ≈ 110 MW
HP 8601
0 - 9 db STEP ATTN
0 - 90 db STEP ATTN
* 10 dB FIXED ATTN.
DETECTOR
319067
MICROWAVE UNIT
7000A

*NARDA MODEL 779-10 FIXED 10 db PAD SELECTED FOR VSWR < 1.05 AT THE TEST FREQUENCY (50 MHZ OR 100 MHZ)

Figure 4-5A. High Precision Power Meter Linearity Test

NOTE

> There are no range to range accuracy adjustments on the multimeter. If the unit fails, refer to Figure 4-16-4 after reviewing paragraph 4.5, Troubleshooting.

4.2.4.9.4. Total Uncertainty Computation For Power Meter Linearity Test.

Total uncertainty = Calibration test system uncertainty + 7000A uncertainty

Total uncertainty = [attenuation uncertainty of 1 db step attenuator + attenuation uncertainty of 10 db step attenuator + mismatch uncertainty of test port.] + [7000A uncertainty]

Substituting in the specifications for the listed equipment:

Total uncertainty = [±.25db (1db step) ±.25db (10db step) ±20 Log $(1 + \rho_g \cdot \rho_L)$] ±.15dB (7000A)

Where: ρ_g = reflection coefficient at the test port (10db step atten.).

ρ_L = reflection coefficient of the detector.

specification for ρ_g and ρ_L = .09

Total uncertainty = [±.25db ±.25db .07db] ±.15db

Total uncertainty - ±.057db ±.15db = ±.72db

Example: Step Attenuator at 32db

Calculated reading = +10 dbm - (Δ step attenuation*)

= +10 dbm - (22 dB)

= -12.0 dbm

The 7000A should read -12.0 dbm ±0.7db

*Δ step attenuation is the difference between the step attenuator setting and the 10 dB that was used to set the reference +10 dBm level.

4.2.4.9.5. Total system uncertainty may be substantially reduced by calibrating the step attenuator at the calibration frequency before calibrating the multimeter. Referring to the total uncertainty computation in 4.2.4.9.4., ±.5 dB of the total ±.57 dB calibration test system uncertainty is caused by attenuation uncertainty.

4.2.4.9.6. A further reduction in calibration uncertainty may be made by adding a fixed 10 dB attenuator having a reflection coefficient $\leq .02$ between the detector of the microwave unit and the 10 dB step attenuator. Narda fixed attenuators 779 series typically have reflection coefficients of $\leq .02$ at RF frequencies. Paragraph 4.2.4.9.7 provides an example of calibration uncertainty reduction.

4.2.4.9.7. As an example, if the test set up of Figure 4-5A is used and is calibrated to an accuracy of ±.07 dB the accuracy of measurement can be improved to ±.09 dB. Substituting in the equation under paragraph 4.2.4.9.4:

$$\text{Total uncertainty} = [\pm \text{atten uncertainty} \pm 20 \text{ Log } (1 \pm \rho_g \rho_L)] \pm \text{7000A uncertainty}$$

$$= [\pm .07 \pm 20 \text{ Log } (1 \pm (.024 \times .09))] \pm .15 \text{ db}$$

$$= [\pm .07 \pm 0.020] \pm .15 \text{ db}$$

$$= \pm .09 \pm .15 \text{ db}$$

$$= \pm 0.24 \text{ db}$$

4.2.5. Signal Generator Test. After completing the power meter test, perform the following test to verify accuracy of the signal generator section. (Troubleshooting ref: Figure 4-16-5)

4.2.5.1. Connect the equipment as shown in Figure 4-6 or 4-7, (the 7200 series microwave unit, illustrated in Figure 4-6 is preferred for this test) and proceed as follows:

4.2.5.2. Press VDC and note that the "OSC ON" LED located on the microwave unit's front panel is off.

4.2.5.3. Press 2nd and SIG GEN and note that the "OSC ON" LED is now on.

4.2.5.4. Press 2nd and then 52 PTS set single freq/auto step to auto/step. Press 2nd and then DISP WAIT. Press INS LOSS. Remove the detector from any source of RF power and press 2nd and then CALIB. Then press CONT.

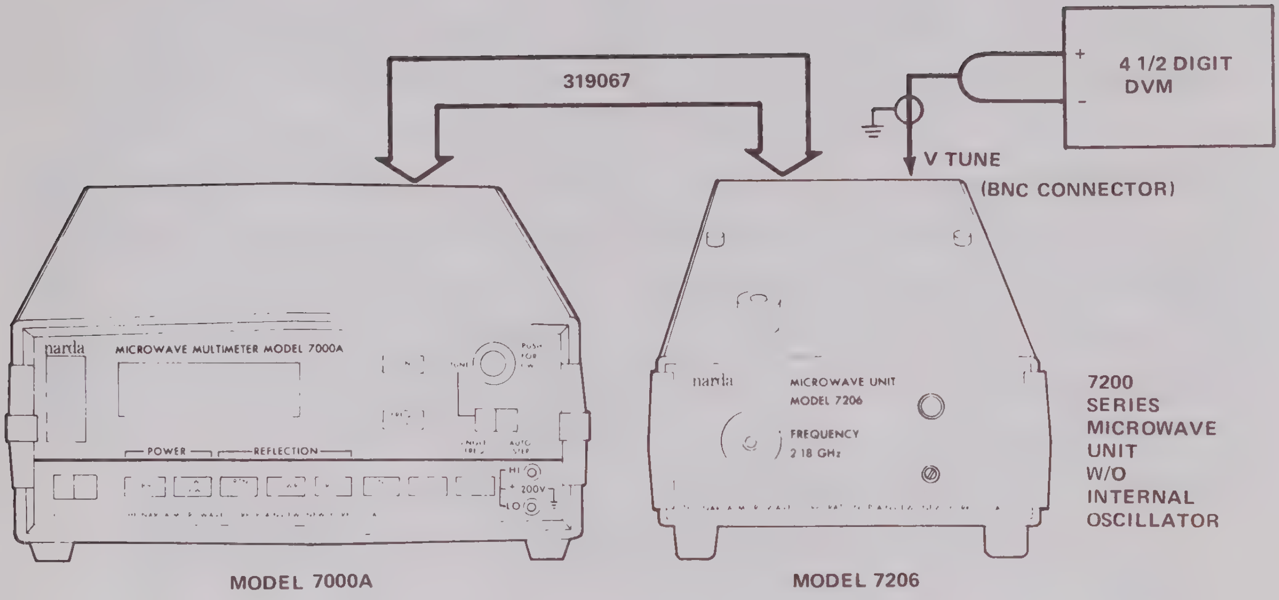

319067
4 1/2 DIGIT DVM
+
-
V TUNE
(BNC CONNECTOR)
narda
MICROWAVE MULTIMETER MODEL 7000A
POWER
REFLECTION
HI
200V
LO
narda
MICROWAVE UNIT
MODEL 7206
FREQUENCY
2-18 GHz
7200 SERIES MICROWAVE UNIT W/O INTERNAL OSCILLATOR
MODEL 7000A
MODEL 7206

Figure 4-6. Signal Generator Test with 7200 Series Microwave Unit

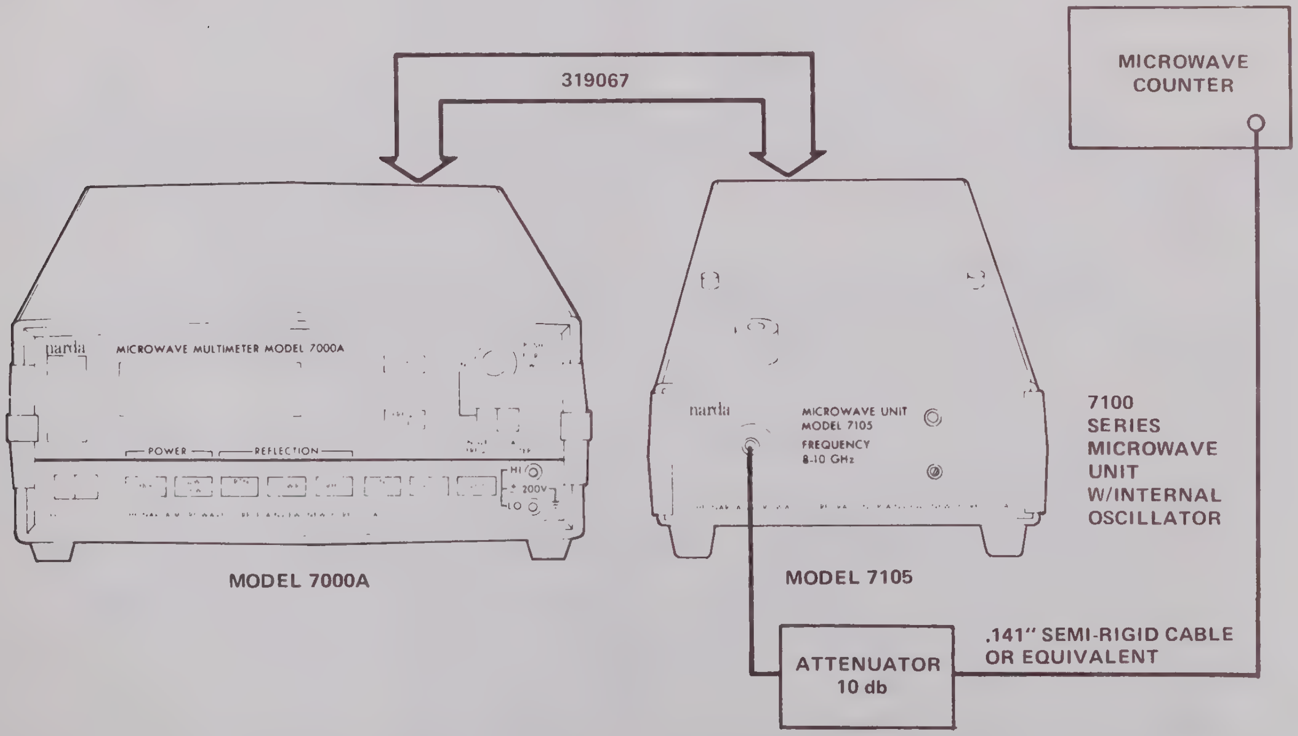

319067
MICROWAVE COUNTER
narda
MICROWAVE MULTIMETER MODEL 7000A
POWER
REFLECTION
HI
200V
LO
narda
MICROWAVE UNIT
MODEL 7105
FREQUENCY
8-10 GHz
7100 SERIES MICROWAVE UNIT W/INTERNAL OSCILLATOR
MODEL 7000A
MODEL 7105
ATTENUATOR 10 db
.141" SEMI-RIGID CABLE OR EQUIVALENT

Figure 4-7. Signal Generator Test with 7100 Series Microwave Unit

4.2.5.5. If the signal generator test will be performed with a 7200 series microwave unit as illustrated in Figure 4-6, proceed as follows starting with paragraph 4.2.5.5.1. If not, go to paragraph 4.2.5.6.

4.2.5.5.1. After "dut" is displayed on the multimeter's LCD, press CONT . The DVM should now read 0.000 volts ±20 mV. Referring to Figure 6-3 in Section VI of this manual, adjust A2 (digital board) R9 (osc offset) for compliance.

4.2.5.5.2. After two seconds have elapsed, press CONT again. The voltage read on the DVM should be 0.200 ±.030 volts.

4.2.5.5.3. Repeat 4.2.5.5.2 until the voltage read is 10 volts and note that the voltage rises by 200 mV for each step. Each step should be within 30 mV of the nominal expected voltage except for the 10.00V step which should be within 20 mV. Adjust A2 R7 (OSC gain) for compliance.

4.2.5.5.4. Press 2nd and MIN MAX . This will clear the multimeter of the DISP WAIT mode.

4.2.5.5.5. Press 2nd and SIG GEN . Again, rotate the "TUNE" control knob and note that the voltage displayed on the multimeter's LCD is within ±20 mV of the voltage read on the DVM for voltages less than 2.0 volts, and within 50 mV for voltages above 2.0 volts.

4.2.5.5.6. Press VDC and connect the 7000A's Hi and Lo leads to ground. Connect the reference DVM Lo lead to the same ground and the Hi lead to A3 TP5. Adjust A3 R28 (voltmeter offset) for a 0.000 Volt ±.005V reading on the reference DVM. See Figure 6-5 in Section VI of this manual for A3 (analog) board information. This completes the signal generator test as illustrated in Figure 4-6. Proceed to paragraph 4.2.6 for sweep generator test.

4.2.5.6. If the signal generator test is performed with a 7100 series microwave unit as illustrated in Figure 4-7, proceed as follows:

4.2.5.6.1. When "dut" is displayed on the multimeter's LCD, press CONT . The counter should read the lowest rated frequency for the microwave unit used, to within the microwave unit's accuracy, as specified in the microwave unit's manual.

4.2.5.6.2. If a calibrated microwave unit is being used, adjust A2 R9 (osc offset) for compliance with 4.2.5.6.1. Refer to Figure 6-3 in Section VI of this manual for A2 (digital) board information. Otherwise, refer to the microwave unit's manual for the correct adjustment.

4.2.5.6.3. As CONT is repetitively pressed fifty times at intervals of two or more seconds, the frequency on the counter should move in fifty equally spaced steps from the minimum to the maximum rated frequency of the microwave unit. The frequency at each step should be within the accuracy specification of the microwave unit.

4.2.5.6.4. If a calibrated microwave unit is being used, adjust A2 R7 (osc gain) for compliance with 4.2.5.6.3. Otherwise, refer to the microwave unit's manual for the correct adjustment.

NOTE

FREQ DISP may be pressed at any time during the signal generator test to display the frequency of the multimeter's LCD that should be read on the counter. The difference between the LCD and the counter is the frequency error. Pressing FREQ DISP will not increment the multimeter to the next frequency step.

4.2.5.6.5. After the multimeter has been stepped through the microwave unit's full frequency range, press 2nd and MIN MAX .

4.2.5.6.6. Press 2nd and SIG GEN . Rotate the "TUNE" control knob on the front panel of the multimeter full counterclockwise and note that the minimum frequency displayed on the counter is lower than the rated frequency of the microwave unit being used. Rotating the knob full clockwise will display a maximum frequency that is higher than the microwave unit's rated frequency.

4.2.5.6.7. Rotate the "TUNE" control knob on the front panel of the multimeter to any frequency within the rated frequency range of the microwave unit. The frequency difference between what is indicated on the LCD and on the counter should be within the accuracy specification of the microwave unit.

4.2.5.6.8. If the frequency accuracy specification of the microwave unit is not met, proceed as follows:

4.2.5.6.8.1. Press VDC and connect the multimeter's HI and LO voltmeter leads to ground, AlE3.

4.2.5.6.8.2. Connect the reference DVM's LO to the same ground (A1E3) and its' HI lead to A3TP5.

4.2.5.6.8.3. Adjust A3R28 (voltmeter offset) for a 0.000 reading on the reference DVM.

4.2.5.6.8.4. Repeat step 4.2.5.6.7 to verify that frequency accuracy is now met.

4.2.6. Sweep Generator Test. After completing the signal generator test, perform the following test to verify accuracy of the sweep generator output of the multimeter.

4.2.6.1. Connect the equipment as shown in Figure 4-8.

4.2.6.2. Press 2nd and SWEEP GEN . The oscilloscope should display a trace as shown in Figure 4-9, with the sweep starting at 0.00 V ±30 mV reaching a maximum value of approximately 9 volts. The wave period of this signal should be approximately 35 milliseconds. There are no adjustments for waveshape.

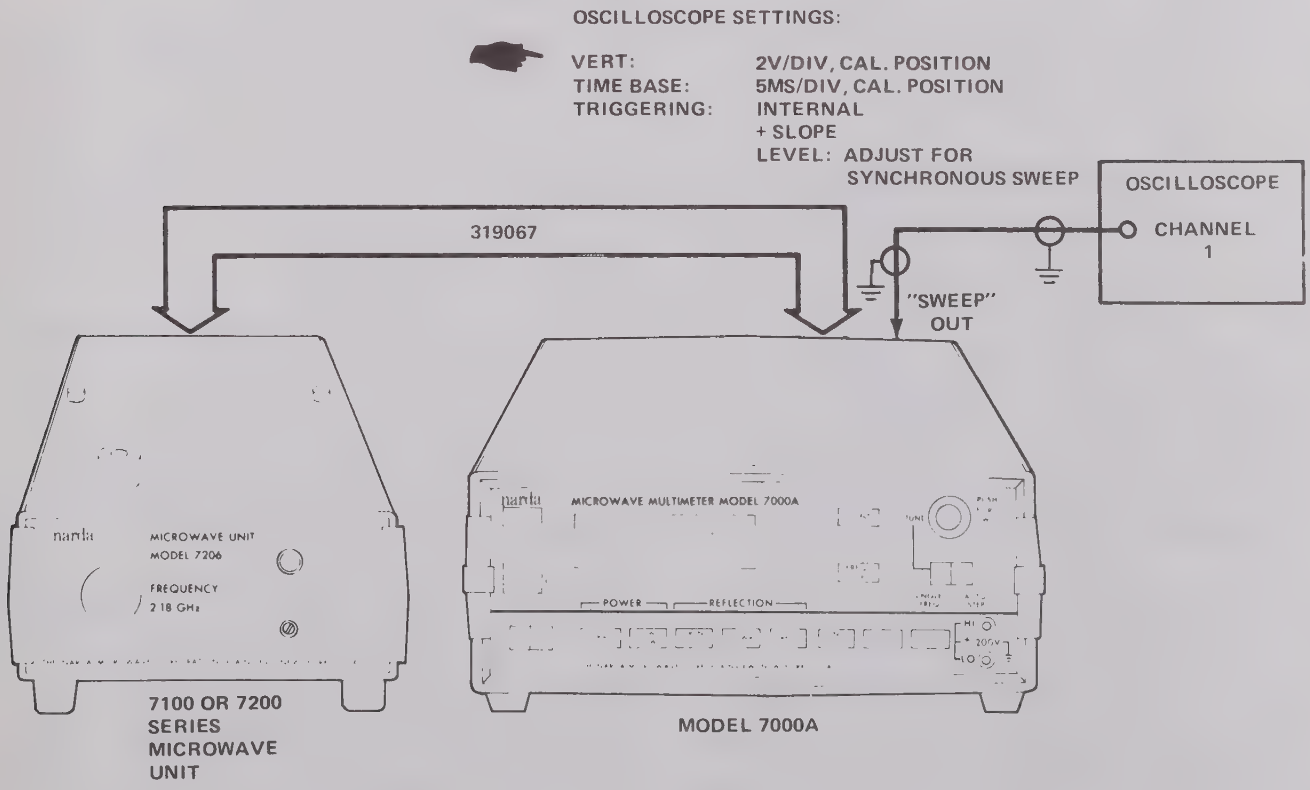

OSCILLOSCOPE SETTINGS:
VERT: 2V/DIV, CAL. POSITION
TIME BASE: 5MS/DIV, CAL. POSITION
TRIGGERING: INTERNAL
+ SLOPE
LEVEL: ADJUST FOR SYNCHRONOUS SWEEP
OSCILLOSCOPE
CHANNEL 1
319067
"SWEEP" OUT
narda
MICROWAVE UNIT
MODEL 7206
FREQUENCY
2.18 GHz
narda
MICROWAVE MULTIMETER MODEL 7000A
POWER
REFLECTION
7100 OR 7200 SERIES MICROWAVE UNIT
MODEL 7000A

Figure 4-8. Sweep Generator Output Test

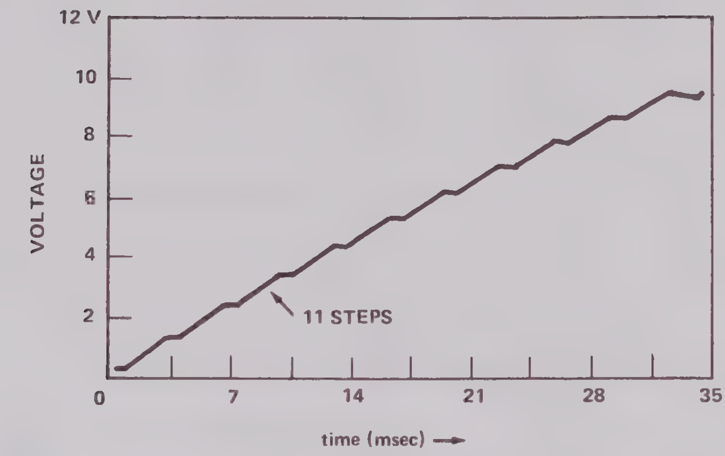


Figure 4-9. Sweep Out Waveshape

NOTE

A momentary flicker on the display will occur as the multimeter's LCD is updated.

4.3. SYSTEM BLOCK DIAGRAM DISCUSSION.

The following paragraphs discuss the functional block diagram of a complete microwave multimeter system, including the microwave unit. Review the system block diagram in Figure 4-10 and this discussion to gain a complete understanding of how the blocks on one pc board are related to blocks on another board. Detailed information about any individual PC board will be found under paragraph 4.4.

4.3.1. The Microprocessor and Associated Circuitry. The microprocessor (marked MPU on the block diagram, Figure 4-10) is the central "brain" of the multimeter. All functions within the unit are controlled directly or indirectly by the microprocessor.

4.3.2. Memory. The memory consists of a program which is stored permanently (EPROM) and a temporary section (RAM) in which data, operational modes, etc. is

Table 4-3

Maintenance Adjustment Summary

NAME	ADJUSTMENT	TEST CONDITIONS
Mech. Zero-analog meter	Adjust lever position in back of meter	Power off
Voltmeter Gain	A3 R47 (D/A Gain)	Multimeter in VDC mode: +19.00 V on HI probe ⏚ on LO probe
LO lead Gain	A3 R23 (Voltmeter Balance)	Multimeter in VDC mode: ⏚ on HI probe +19.00 V on LO probe
+/- Voltage Gain Balance	A3 R47 (D/A Gain)	Multimeter in VDC mode: -19.00 V on HI probe ⏚ on LO probe
+/- Voltage Offset	A3 R37 (Sync. Det. Offset)	Multimeter in VDC mode: ±3.00 V on HI probe ±3.00 V on LO probe
200 V scale Voltmeter Gain	A3 R53 (x.01 Gain)	Multimeter in VDC mode: +190 V on HI probe ⏚ on LO probe
220 Hz Clock	A2 R12 (Freq. Adjust)	Multimeter in Power Meter mode: A2TP2 jumpered to A2 TP3, Set using High Z scope probe into counter.
Power Meter Gain	A3 R7 (Pwr. Meter Cal.)	Multimeter in Power Meter mode: Using a recently calibrated microwave unit and a power reference, Power in = 1.00 mW or 10.00 mW.
Power Meter Gain	A3 R23 (Cal. Adjust on the microwave unit)	Multimeter in Power Meter mode: Use a power reference
Tuning Voltage Offset	A2 R9 (Oscillator Offset)	Multimeter in Insertion Loss mode: 1st step 52 point and Display Wait options selected. Set for 0.00 V @ V Tune using a microwave unit that does not have an internal source. (See Table 1-8)

Table 4-3 (Cont)

NAME	ADJUSTMENT	TEST CONDITIONS
Tuning Voltage Gain	A2 R7 (Oscillator Gain)	Multimeter in Insertion Loss mode: 51 st step, 52 point and Display Wait options selected. Set for 10.00 V @ V Tune using a microwave unit that does not have an internal source. (See Table 1-8)
Signal Generator Frequency Accuracy	A3 R28 (Voltmeter Offset)	Multimeter in VDC mode: Adjust for 0.000 V at A3 TP5 with Voltmeter probes grounded.

stored. The microwave unit has at least one calibration prom which stores data concerning the detector linearity and cal. factors. Some microwave units have a second calibration prom which contains oscillator frequency tuning data.

4.3.3. Decoding. The decoding section controls which device will be able to put data on, or take data off the data bus.

4.3.4. GPIB Option (-02). The GPIB option interfaces the multimeter to an IEEE 488 bus. This allows the unit to be controlled by an external computer and to send data to that computer or other device on the bus.

4.3.5. Mode Control Switches. The mode control switches on the front panel provide the operator with mode control inputs to the multimeter to change the measurement types and modes. The mode control switches go to the front panel decoder/interrupt request generator which interfaces the front panel switches to the microprocessor.

4.3.6. Peripheral Interface Adapter. The PIA (Peripheral Interface Adapter) interfaces the microprocessor to all internal control signals in the multimeter. All range and mode settings, voltage readings and settings, etc. are done through the PIA. The display section, which handles the control and output of the LCD, is also controlled through the PIA.

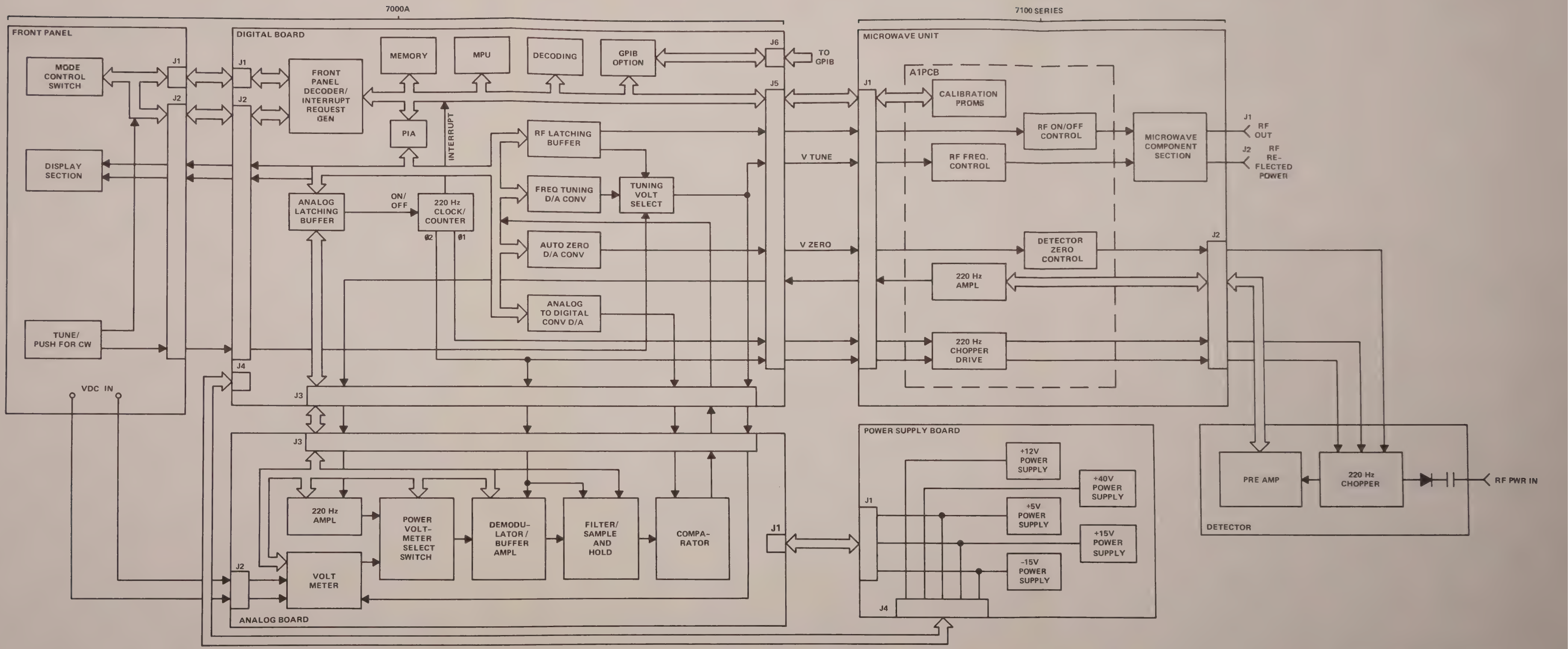

7000A
7100 SERIES
FRONT PANEL
MODE CONTROL SWITCH
DISPLAY SECTION
TUNE/ PUSH FOR CW
VDC IN
J1
J2
DIGITAL BOARD
J1
J2
J4
J3
J5
J6
FRONT PANEL DECODER/ INTERRUPT REQUEST GEN
MEMORY
MPU
DECODING
GPIB OPTION
TO GPIB
PIA
INTERRUPT
ANALOG LATCHING BUFFER
ON/ OFF
220 Hz CLOCK/ COUNTER
Ø2
Ø1
RF LATCHING BUFFER
FREQ TUNING D/A CONV
TUNING VOLT SELECT
AUTO ZERO D/A CONV
ANALOG TO DIGITAL CONV D/A
V TUNE
V ZERO
ANALOG BOARD
J3
J2
J1
220 Hz AMPL
POWER VOLT-METER SELECT SWITCH
DEMODU-LATOR / BUFFER AMPL
FILTER/ SAMPLE AND HOLD
COMPA-RATOR
VOLT METER
MICROWAVE UNIT
J1
J2
A1PCB
CALIBRATION PROMS
RF ON/OFF CONTROL
RF FREQ. CONTROL
MICROWAVE COMPONENT SECTION
J1 RF OUT
J2 RF RE-FLECTED POWER
DETECTOR ZERO CONTROL
220 Hz AMPL
220 Hz CHOPPER DRIVE
POWER SUPPLY BOARD
J1
J4
+12V POWER SUPPLY
+40V POWER SUPPLY
+5V POWER SUPPLY
+15V POWER SUPPLY
-15V POWER SUPPLY
DETECTOR
PRE AMP
220 Hz CHOPPER
RF PWR IN

Figure 4-10. Block Diagram: Microwave Multimeter With Microwave Unit

4.3.6.1. Devices Controlled through the PIA. The following paragraphs identify devices that are controlled through the PIA, and briefly identifies events controlled by these devices:

4.3.6.1.1. Auto-Zero D/A Converter controls the zero bias to the microwave detector through the detector zero control. The detector zero control output goes to the 220 Hz chopper in the detector, through the signal line labelled V ZERO.

4.3.6.1.2. Frequency Tuning D/A Converter. The frequency tuning D/A converter controls the frequency of the microwave oscillator when the multimeter is in auto-step or sweep mode. The output of the frequency tuning D/A converter goes to the tuning voltage select switch which selects either the D/A voltage or the voltage from the TUNE/PUSH for CW control for the RF frequency control circuit. The RF frequency control output tunes the frequency of the microwave component section through the signal line labelled V TUNE.

4.3.6.1.3. RF Latching Buffer. The RF Latching Buffer controls the state of both the tuning voltage select switch and the RF on/off control which in turn controls the operation of the microwave component section.

4.3.6.1.4. Analog Latching Buffer. The analog latching buffer controls range and input selections, signal path and polarity of the analog signals. The buffer also controls the operation of the 220 Hz clock/counter.

4.3.7. Power Meter Analog Circuits. The following paragraphs explain signal flow through devices comprising power meter analog circuits:

4.3.7.1. 220 Hz clock/counter. The 220 Hz clock/counter has several functions. The interrupt pulse it generates is used by the microprocessor as a timer. In addition, its two-phase clock output is used to modulate and demodulate the detected microwave signal.

3.4.7.2. Power Meter Chopper Drive. The 220 Hz clock signals go to the Power Meter Chopper Drive which drives the Power Meter Chopper in the detector. This converts the DC voltage out of the detector to an AC signal whose amplitude is proportional to the microwave signal's amplitude.

4.3.7.3. Power Meter Preamplifier. This AC signal is then amplified in the power meter preamp which feeds it to the power meter amplifier in the microwave unit.

4.3.7.4. Power Meter Amplifier. This signal is then fed into the power meter amplifier on the analog board. The output of this amplifier goes to the power/voltmeter select switch. If the multimeter is in a power reading operation, the signal will be passed through this selector switch into the demodulator/buffer amp where the signal is demodulated and sent to the filter/sample & hold where the signal is filtered and then sampled in sync with the 220 Hz clock. The hold part of this circuit keeps the sampled voltage constant and feeds it into the voltage comparator.

4.3.8. Voltmeter. The voltmeter is used to convert the DC voltage being read into a level that is measurable by the system. The output of the voltmeter goes to the power/voltmeter select switch. If the unit is in voltage mode the selector switch will pass the voltage to the demodulator/buffer amp, which is used to control the polarity of the voltage into the filter/sample & hold and into the comparator.

4.3.9. Analog to Digital Conversion. The following paragraphs explain events that occur within the comparator and the microprocessor during A/D conversion.

4.3.9.1. Comparator. The comparator and analog to digital converter D/A are used together to convert the analog voltage present at the + input of the comparator to a digital number which can be used by the MPU.

4.3.9.2. Microprocessor Unit. The MPU programs the D/A converter (through the PIA) to a known voltage. This voltage is sent to the - input of the comparator. The MPU then reads the logic level of the comparator output to determine whether the D/A output voltage is greater or less than the voltage at the output of the sample & hold. By changing the known D/A Voltage, one bit at a time using a successive approximation technique, the unknown voltage is determined.

NOTE

> If the D/A voltage is greater than the voltage out of the Sample & Hold, the comparator output will go to logic 0. If the D/A voltage is less than the Sample & Hold voltage the comparator output will go to logic I.

4.3.10. Power Supplies. The power supplies used in the multimeter are +5V, +15V, -15V, +12V (Battery voltage in the Model 7000A-01) and +40V. The 7000A uses only the +5V, +15V and -15V power supplies. The +12V and +40V power supplies are only used in the microwave unit along with the other supplies.

4.4. BLOCK DIAGRAM OF PC BOARDS.

This discussion covers individual block diagrams for the power supply (A4) PC board for the Model 7000A multimeter, power supply (A4) PC board for the Model 7000A-01 (battery option) multimeter and for the following PC boards that are common to both units; digital board (A2), front panel board (A1) and analog board (A3). Components associated with each block are called out in that block and are enclosed by parenthesis. Test points are also identified. All I.C.'s are socket mounted instead of being soldered directly to the PC boards, to facilitate replacement and to eliminate the possibility of lifting PC board lands, breaking feed through eyelets and solder splashes. When changing I.C.'s use a CMOS safe extractor and insertion tool. Place I.C.'s in conductive foam when not in printed circuit board.

4.4.1. Power Supply (A4) PC Board for Model 7000A and associated circuits. Refer to Figure 4-11 and Figure 6-1 in Section VI of this manual. AC power comes in by way of the rear panel through the fuse and line filter segment of FL1 to the front panel power ON/OFF switch. It is then routed back to FL1's line voltage selection segment and connected to the primaries of T1. Transformer T1 has five secondary windings. These are sent to the +5V, +15V, -15V and +12V regulated power supplies and to the +40V unregulated power supply.

4.4.1.1. The four regulated supplies function in the same manner. The +15V regulated supply is discussed here as an example. The AC from the 15 Volt secondary of T1 is rectified by CR1 (full wave bridge rectification). Capacitor C1 is the input filter/storage capacitor. The rectified and filtered voltage is then regulated by U1. Capacitor C8 further filters the regulated output voltage. C6 and C7 frequency stabilize U1 to prevent oscillation.

4.4.1.2. The 40V power supply is unregulated. Diode CR5 provides half wave rectification of the AC input from T1 and capacitor C5 is the input filter/storage capacitor. Resistor R1 limits the current to the clamping diode (CR6). Capacitors C18 and C19 provide output voltage filtering.

4.4.1.3. The ±15V and 5V power supply outputs are connected via J1 to the analog PC board (A3) and all the power supply outputs are connected to J1 on the digital PC board, (A2).

4.4.1.4. Test points are provided to monitor the output voltages of all five power supplies. An additional test point provided, is connected to the chassis ground (⏚).

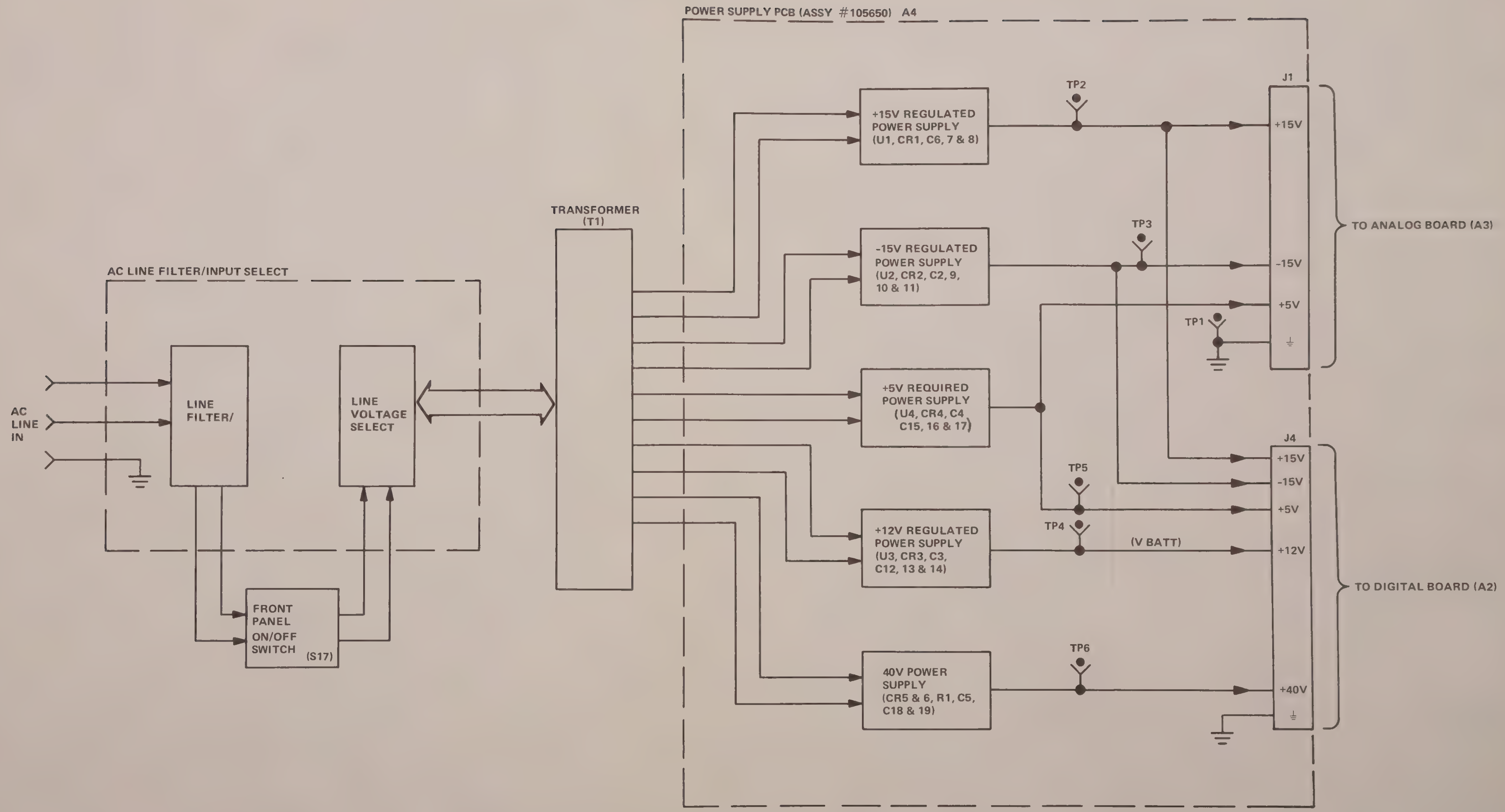

POWER SUPPLY PCB (ASSY #105650) A4
AC LINE FILTER/INPUT SELECT
AC LINE IN
LINE FILTER/
LINE VOLTAGE SELECT
FRONT PANEL ON/OFF SWITCH (S17)
TRANSFORMER (T1)
+15V REGULATED POWER SUPPLY (U1, CR1, C6, 7 & 8)
-15V REGULATED POWER SUPPLY (U2, CR2, C2, 9, 10 & 11)
+5V REQUIRED POWER SUPPLY (U4, CR4, C4 C15, 16 & 17)
+12V REGULATED POWER SUPPLY (U3, CR3, C3, C12, 13 & 14)
40V POWER SUPPLY (CR5 & 6, R1, C5, C18 & 19)
TP1
TP2
TP3
TP4
TP5
TP6
(V BATT)
J1
+15V
-15V
+5V
⏚
J4
+15V
-15V
+5V
+12V
+40V
⏚
TO ANALOG BOARD (A3)
TO DIGITAL BOARD (A2)

Figure 4-11. Model 7000A Power Supply (A4) Block Diagram

4.4.2. Power Supply (A4) PC Board for Model 7000A-01 (battery option) and associated circuits. Refer to Figure 4-12 and Figure 6-2 in Section VI of this manual. The AC into the adapter/charger (CP1) is stepped down (full wave) rectified and filtered. The output at CP1 is connected to J1 on the rear panel of the 7000A-01 where the negative (low) lead is connected to chassis ground.

4.4.2.1. When the multimeter is turned off, the positive lead of CP1 is connected to the dropping (current limiting) resistor (R1) and is then connected to the battery so that the battery charges. When the multimeter is turned on, the dropping resistor is shorted by the front panel switch (S17) and the positive battery lead is connected to J2 of the power supply pc board (A4).

4.4.2.2. The +15V and -15V regulated power supply voltages are produced by the DC/DC converter (PS2). Capacitors C3 and C4 provide input filtering for PS2 and C16 and C17 are output filtering capacitors.

4.4.2.3. The +5V regulated power supply voltage is provided by the DC/DC converter (PS1). Capacitors C1 and C2 provide input filtering for PS1 and C15 is the output filtering capacitor.

4.4.2.4. The unregulated +40V power supply is produced by chopping the input battery voltage and multiplying it by use of a diode and capacitor network and then filtering and clamping the output. The chopping is done by U1 and its associated components, R1, R2, C5 and C14. The voltage multiplication is done by diodes CR1 through CR8 and capacitors C6 through C12. Resistor R3 and capacitor C13 filter the output. Additionally, R3 acts as a current limiting resistor. Diode CR9 clamps the output voltage.

4.4.2.5. The ±15V and +5V power supplies are connected via J1 to the analog pc board (A3). The ±15V, +5V and +40V are connected to J4 on the digital pc board (A2). Additionally, the input battery voltage is connected to J4.

4.4.3. Digital (A2) PC Board. Refer to Figure 4-13 and Figure 6-3 in Section VI of this manual. The digital PC board may be functionally divided into three main parts. The discussion of the board will follow this functional division. The first part will be a discussion of fundamental blocks that only give inputs to the microprocessor (mode and control inputs). The second part will be a discussion of the functional blocks having inputs and outputs that are controlled directly by the microprocessor. The third part will be a discussion of the functional blocks having inputs and outputs that are controlled by the microprocessor through the peripheral interface adapter.

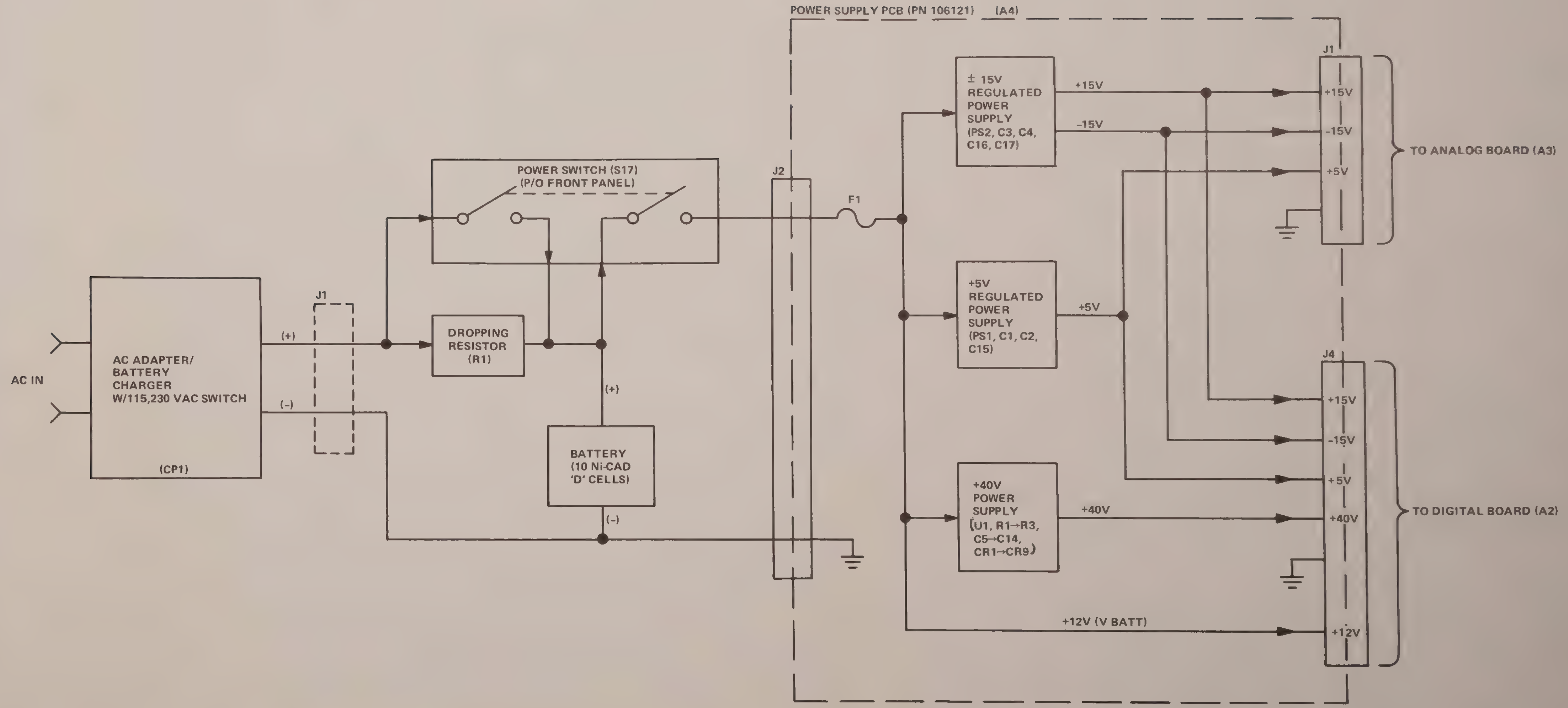
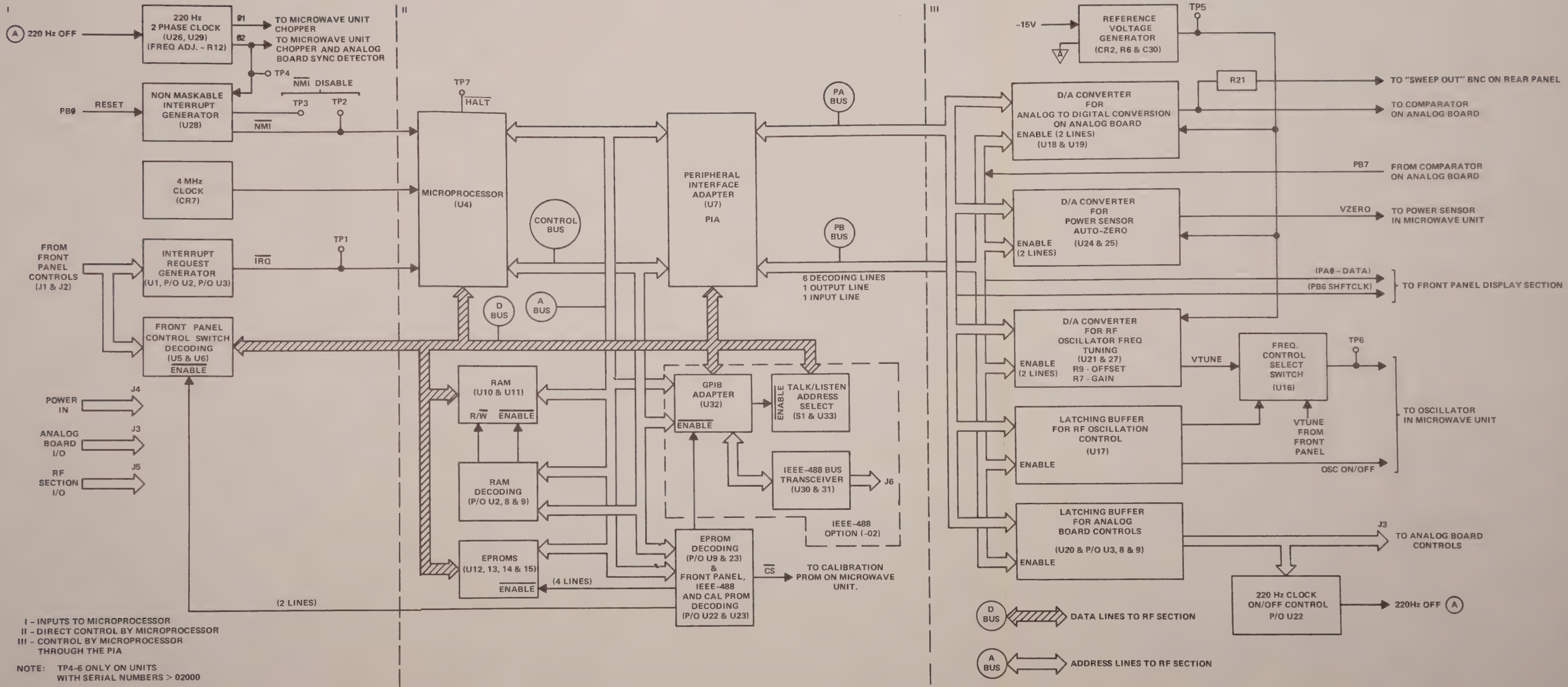

POWER SUPPLY PCB (PN 106121) (A4)
AC IN
AC ADAPTER/ BATTERY CHARGER W/115,230 VAC SWITCH
(CP1)
(+)
(–)
J1
POWER SWITCH (S17) (P/O FRONT PANEL)
DROPPING RESISTOR (R1)
BATTERY (10 Ni-CAD 'D' CELLS)
(+)
(–)
J2
F1
± 15V REGULATED POWER SUPPLY (PS2, C3, C4, C16, C17)
+15V
–15V
+5V REGULATED POWER SUPPLY (PS1, C1, C2, C15)
+5V
+40V POWER SUPPLY (U1, R1→R3, C5→C14, CR1→CR9)
+40V
+12V (V BATT)
J1
+15V
-15V
+5V
TO ANALOG BOARD (A3)
J4
+15V
-15V
+5V
+40V
+12V
TO DIGITAL BOARD (A2)

Figure 4-12. Model 7000A-01 Power Supply (A4) Block Diagram


I
A 220 Hz OFF
220 Hz 2 PHASE CLOCK (U26, U29) (FREQ ADJ. - R12)
Ø1
Ø2
TO MICROWAVE UNIT CHOPPER
TO MICROWAVE UNIT CHOPPER AND ANALOG BOARD SYNC DETECTOR
TP4
NMI DISABLE
PBØ
RESET
NON MASKABLE INTERRUPT GENERATOR (U28)
TP3
TP2
NMI
4 MHz CLOCK (CR7)
FROM FRONT PANEL CONTROLS (J1 & J2)
INTERRUPT REQUEST GENERATOR (U1, P/O U2, P/O U3)
IRQ
TP1
FRONT PANEL CONTROL SWITCH DECODING (U5 & U6) ENABLE
POWER IN
J4
ANALOG BOARD I/O
J3
RF SECTION I/O
J5
II
TP7
HALT
MICROPROCESSOR (U4)
CONTROL BUS
D BUS
A BUS
RAM (U10 & U11) R/W ENABLE
RAM DECODING (P/O U2, 8 & 9)
EPROMS (U12, 13, 14 & 15) ENABLE
(4 LINES)
(2 LINES)
PERIPHERAL INTERFACE ADAPTER (U7) PIA
PA BUS
PB BUS
6 DECODING LINES
1 OUTPUT LINE
1 INPUT LINE
GPIB ADAPTER (U32) ENABLE
ENABLE
TALK/LISTEN ADDRESS SELECT (S1 & U33)
IEEE-488 BUS TRANSCEIVER (U30 & 31)
J6
IEEE-488 OPTION (-02)
EPROM DECODING (P/O U9 & 23) & FRONT PANEL, IEEE-488 AND CAL PROM DECODING (P/O U22 & U23)
CS
TO CALIBRATION PROM ON MICROWAVE UNIT.
III
-15V
A
REFERENCE VOLTAGE GENERATOR (CR2, R6 & C30)
TP5
R21
TO "SWEEP OUT" BNC ON REAR PANEL
D/A CONVERTER FOR ANALOG TO DIGITAL CONVERSION ON ANALOG BOARD
ENABLE (2 LINES) (U18 & U19)
TO COMPARATOR ON ANALOG BOARD
PB7
FROM COMPARATOR ON ANALOG BOARD
D/A CONVERTER FOR POWER SENSOR AUTO-ZERO (U24 & 25)
ENABLE (2 LINES)
VZERO
TO POWER SENSOR IN MICROWAVE UNIT
(PAØ - DATA)
(PB6 SHFTCLK)
TO FRONT PANEL DISPLAY SECTION
D/A CONVERTER FOR RF OSCILLATOR FREQ TUNING (U21 & 27) R9 - OFFSET R7 - GAIN
ENABLE (2 LINES)
VTUNE
FREQ. CONTROL SELECT SWITCH (U16)
TP6
VTUNE FROM FRONT PANEL
TO OSCILLATOR IN MICROWAVE UNIT
LATCHING BUFFER FOR RF OSCILLATION CONTROL (U17)
ENABLE
OSC ON/OFF
LATCHING BUFFER FOR ANALOG BOARD CONTROLS (U20 & P/O U3, 8 & 9)
ENABLE
J3
TO ANALOG BOARD CONTROLS
220 Hz CLOCK ON/OFF CONTROL P/O U22
220Hz OFF A
D BUS
DATA LINES TO RF SECTION
A BUS
ADDRESS LINES TO RF SECTION

I - INPUTS TO MICROPROCESSOR
II - DIRECT CONTROL BY MICROPROCESSOR
III - CONTROL BY MICROPROCESSOR THROUGH THE PIA

NOTE: TP4-6 ONLY ON UNITS WITH SERIAL NUMBERS > 02000

Figure 4-13. Digital Board (A2) Block Diagram

NOTE

> Because of the number of components on the digital PC board, only the IC's are shown on the block diagram.

4.4.3.1. Mode and Control Inputs to Micrprocessor. The front panel pushbutton control lines come in through J1 and J2 and are terminated at the interrupt control generator. These same lines are also brought to the front panel control switch decoding section. When a front panel pushbutton is pressed an interrupt request ($\overline{\text{IRQ}}$) is generated. This interrupt directs the microprocessor to scan the outputs of the front panel switch decoding to determine which pushbutton is being pressed.

4.4.3.1.1. The 4 MHz clock determines the timing for all digital processes in the multimeter.

4.4.3.1.2. The 220 Hz clock is used to both modulate and demodulate the analog signal from the microwave detector. Additionally, the 220 Hz clock output is sent to the nonmaskable interrupt ($\overline{\text{NMI}}$) generator. The $\overline{\text{NMI}}$ generator counts the number of 220 Hz clock cycles and on the one hundredth cycle, generates the $\overline{\text{NMI}}$ signal. This 100 cycle duration is long enough for the analog signal from the microwave detector to propagate through all the analog circuitry and then to stabilize. When the $\overline{\text{NMI}}$ signal is sent to the microprocessor it terminates the analog signal portion of the measurement cycle and begins the digital processing of the obtained signal level. The inputs to the 220 Hz clock and $\overline{\text{NMI}}$ generator (220 Hz off and reset, respectively) are controlled by the microprocessor through the peripheral interface adapter (PIA).

4.4.3.2. Functional Blocks Controlled Directly by the Microprocessor. The microprocessor controls which device may take data from or place data on the data bus through the decoding sections. The block diagram, Figure 4-13, shows these decoding sections for the RAM, EPROMS, front panel, IEEE-488 and cal PROMS. Additionally, the peripheral interface adapter has internal decoding that receives its inputs from address lines A12, A13 and A14.

4.4.3.2.1. The EPROMS (Erasable Programmable Read Only Memory) contain the programming instructions for the microprocessor. These instructions tell the microprocessor what to do and the order in which it is to be done. The EPROMS are programmed at the factory and maintain their information when system power is turned off.

4.4.3.2.2. The RAM (Random Access Memory) section is used by the microprocessor as a "scratch pad" to temporarily store numbers and operational modes. The RAMS lose their data when the system power is turned off or interrupted. The RAMS may either take data from (microprocessor write operation) or put data on (microprocessor read operation) the data bus depending upon the state of the $R/\overline{W}$ control line. It may be noted from the preceding statement that the read and write operations are referenced to what the microprocessor is doing and not to what the controlled device is doing.

4.4.3.2.3. The IEEE-488 (Remote Operation, option -02) section is used to interface the multimeter to the IEEE-488 bus. This allows the multimeter to be controlled by, and/or to send data to other instruments. The IEEE-488 bus transceivers buffer the IEEE-488 bus from the GPIB adapter which handles the specialized functions of the bus (handshake and bus management lines). The talk/listen address select section sets the address to which the multimeter will respond.

4.4.3.2.4. The calibration PROM(S) located in the microwave unit are read directly by the microprocessor through its' address and data bus. The microwave units' PROM(S) are decoded on the digital PC board as shown in the block diagram, Figure 4-13.

4.4.3.2.5. The PIA (Peripheral Interface Adapter) is used by the microprocessor to control the D/A converters and latching buffers, to send data to the front panel display section and to read data from the comparator on the analog PC board. A simple description would be that the PIA is a bi-directional 8P2T digital switch, in that it has 4 modes of operation involving the 8 data lines: The PIA may take data from the data bus and switch it to either the PA or PB bus, or it may take data from either the PA or PB bus and transfer it to the data bus. The microprocessor controls which mode is selected and when the PIA is to transfer data.

4.4.3.3. Functional Blocks Controlled by the Microprocessor Through the PIA. There are two latching buffers controlled through the PIA. The analog board control buffer sets the ranges, polarity and modes (power/voltage) on the analog board. Two of its outputs also go to the 220 Hz clock on/off control. The RF oscillator control buffer turns the microwave unit's oscillator on and off and also selects either the front panel tune pot voltage or the frequency tuning D/A converter voltage to go through the frequency control select switch to the oscillator's frequency control input. Both buffers have internal latching to hold their outputs at constant logic levels until they are reprogrammed through the PIA to change states. The PA bus is used to transfer data and the PB bus is used to decode (enable) the buffers.

4.4.3.3.1. Three, latching, D/A (digital to analog) converters are controlled through the PIA. All three D/A converters receive their voltage reference from the reference voltage generator, which is the only functional block on the digital PC board that is completely independent of the microprocessor. Additionally, the outputs of the D/A converters are buffered by op amps. The latching capability of the D/A converters allows them to maintain constant output voltages until they are reprogrammed through the PIA. Again the PA bus is used to transmit data to the D/A converters and the PB bus is used to decode them.

4.4.3.3.1.1. The frequency tuning D/A converter supplies a tuning voltage to the internal oscillator in the microwave unit or to the external source of a microwave unit without its own oscillator, (7200 Series). The output buffer for this D/A converter has offset and gain controls.

4.4.3.3.1.2. The power sensor auto-zero D/A converter supplies the RF detector zeroing voltage (VZERO) to the microwave unit.

4.4.3.3.1.3. The third D/A converter is used in conjunction with the "comp out" signal from the analog PC board to convert the analog signal level at the input of the comparator to a digital number usable by the microprocessor. The operational flow of events and the components used in this process are as follows: The "comp out" signal from the analog board is connected to PB7. When the logic state of this line is to be read, the PIA is programmed to transfer the data from the PB bus to the data bus and the microprocessor reads data D7. A "comp out" logic state "O" indicates that the D/A voltage (through the analog board's voltage divider) is higher than the analog signal voltage. A logic state "1" indicates the D/A voltage through the analog boards voltage divider is lower than the analog signal voltage. The D/A converter is stepped 10 times to make a voltage measurement. In the first step the MSB is set high and all other bits low, the "comp out" line is then read. If the "comp out" line is at a "1" state then the MSB will be left high for the remaining 9 steps. If the "comp out" line is set at a "0" state, then the MSB will be set and left low for the remaining 9 steps. The next highest bit is then set high and the same procedure of leaving it high or setting it low as determined by the state of the "comp out" line is repeated. When all 10 bits have been tested in this manner, the binary number obtained is then used by the microprocessor in its calculations.

4.4.3.3.1.4. The third D/A converter is also used to generate the stepped ramp to the "SWEEP OUT" BNC connector on the rear panel of the multimeter when it is in sweep generator mode.

4.4.3.3.1.5. Front Panel Display Section. The data to the front panel display section is sent through the PIA to the front panel on the PA 0 (DATA) line. The timing/shifting pulses for this data is sent on the PB6 (SHIFT CLK) line.

4.4.4. Front Panel (A1) PC Board. Refer to Figure 4-14 and Figure 6-4 in Section VI of this manual. The front panel PC board can be functionally divided into two parts: the display section and the control section.

4.4.4.1. The display section of the front panel PC board takes the data from the digital PC board and displays it on the LCD. The 30 Hz clock provides the square wave output to the back plane of the LCD which the LCD requires to function. This square wave is also sent to the shift registers to keep their outputs synchronized with the LCD backplane. Data coming in from the digital PC board is sent to the shift registers. This data is shifted into and across the shift registers in sync with the "SHIFT CLK" signal. The output of the shift registers is sent to the LCD. The LCD segments are "ON" when a 30 Hz AC signal is applied between the backplane and segment input. When this AC signal is 0 volts the segment is off.

4.4.4.2. The control section of the front panel PC board consists of three basic parts. The operational mode control switches, "TUNE" control and power ON/OFF switch.

4.4.4.2.1. The operational mode control switches (VDC , dBm , INS LOSS , etc.) control the mode in which the multimeter will operate. When one of these switches (or push for CW) is pressed, the appropriate line is grounded and the microprocessor responds by changing to the mode selected (as covered in the digital block diagram discussion, paragraph 4.4.3.1).

4.4.4.2.2. The "TUNE" control is used to set the operating frequency in "SINGLE FREQ" operation and to select the end point frequency in "AUTO STEP" and SWEEP operation. It is also used in the power meter mode to correct for calibration factor.

4.4.4.2.3. The power ON/OFF switch functions were covered in the block diagrams for both 7000A and 7000A-01 multimeters under paragraphs 4.4.1 and 4.4.2.

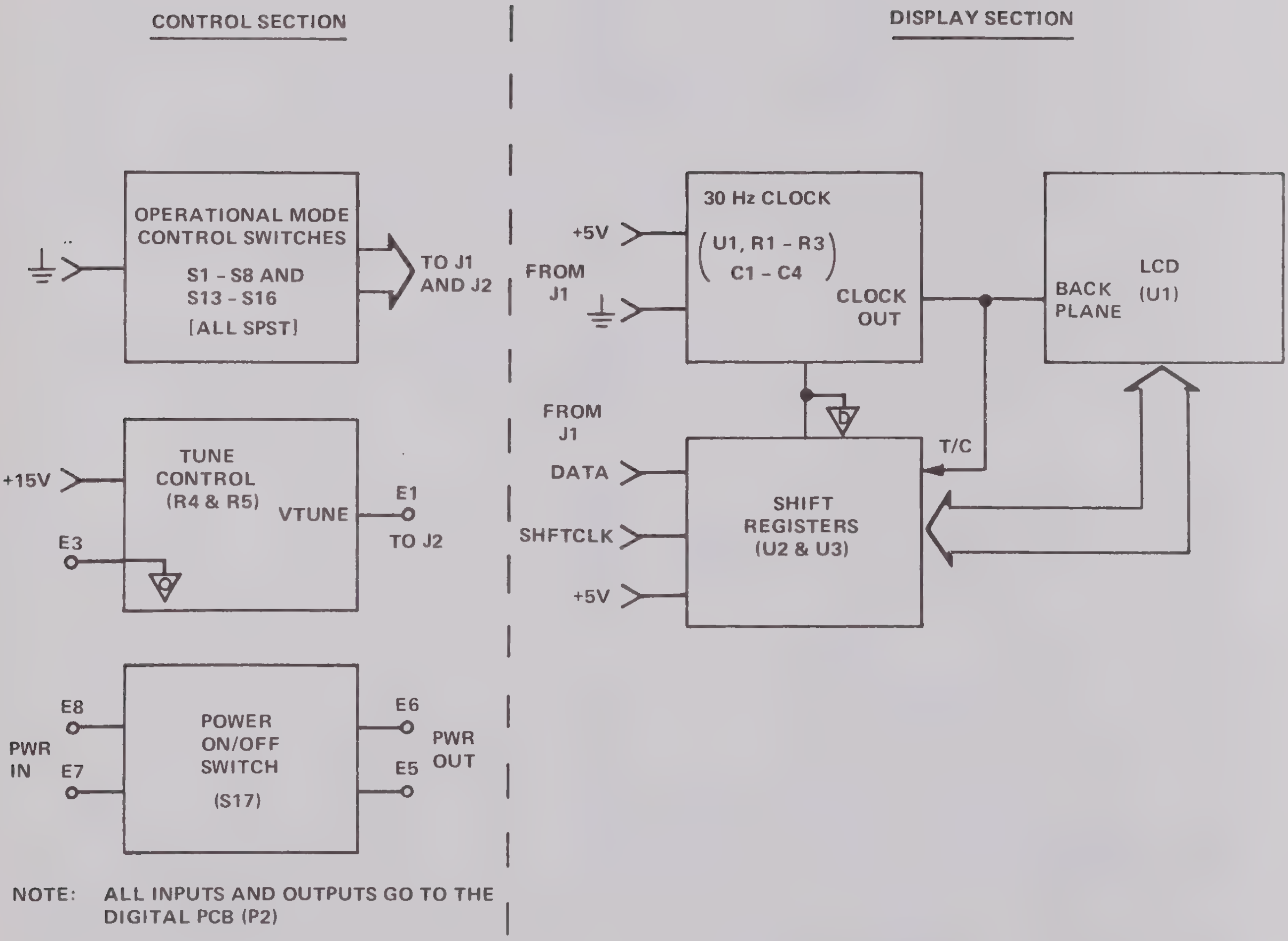

CONTROL SECTION
DISPLAY SECTION
OPERATIONAL MODE CONTROL SWITCHES
S1 - S8 AND S13 - S16
[ALL SPST]
TO J1 AND J2
TUNE CONTROL (R4 & R5)
+15V
VTUNE
E1
TO J2
E3
E8
PWR IN
E7
POWER ON/OFF SWITCH
(S17)
E6
PWR OUT
E5
NOTE: ALL INPUTS AND OUTPUTS GO TO THE DIGITAL PCB (P2)
+5V
FROM J1
30 Hz CLOCK
(U1, R1 - R3 C1 - C4)
CLOCK OUT
LCD (U1)
BACK PLANE
FROM J1
DATA
SHFTCLK
+5V
T/C
SHIFT REGISTERS (U2 & U3)

Figure 4-14. Front Panel Board (A1) Block Diagram

4.4.5. Analog (A3) PC Board. Refer to Figure 4-15 and Figure 6-5 in Section VI of this manual. The analog PC board is functionally divided into four sections; the power meter amplifier, voltmeter, common section and the analog ground generator.

4.3.5.1. The power meter amplifier processes the signal from the microwave unit. The amplifier has high and low pass filters which tune its maximum response for 220 Hz. Because of this filtering, the signal, which at the input has the general shape of an AC coupled square wave, is converted to a sine wave by the time it reaches the output (TP4). The amplifier also has three selectable attenuators that are used to change ranges and are controlled by the digital PC board. The functions, gains (A) and components of each functional block are shown on the block diagram. It may be noted that the same basic sequence of high pass filter, selectable attenuator and amplifier/filter is repeated three times in the amplifier. The output of the power meter amplifier is connected to the common section of the PC board.

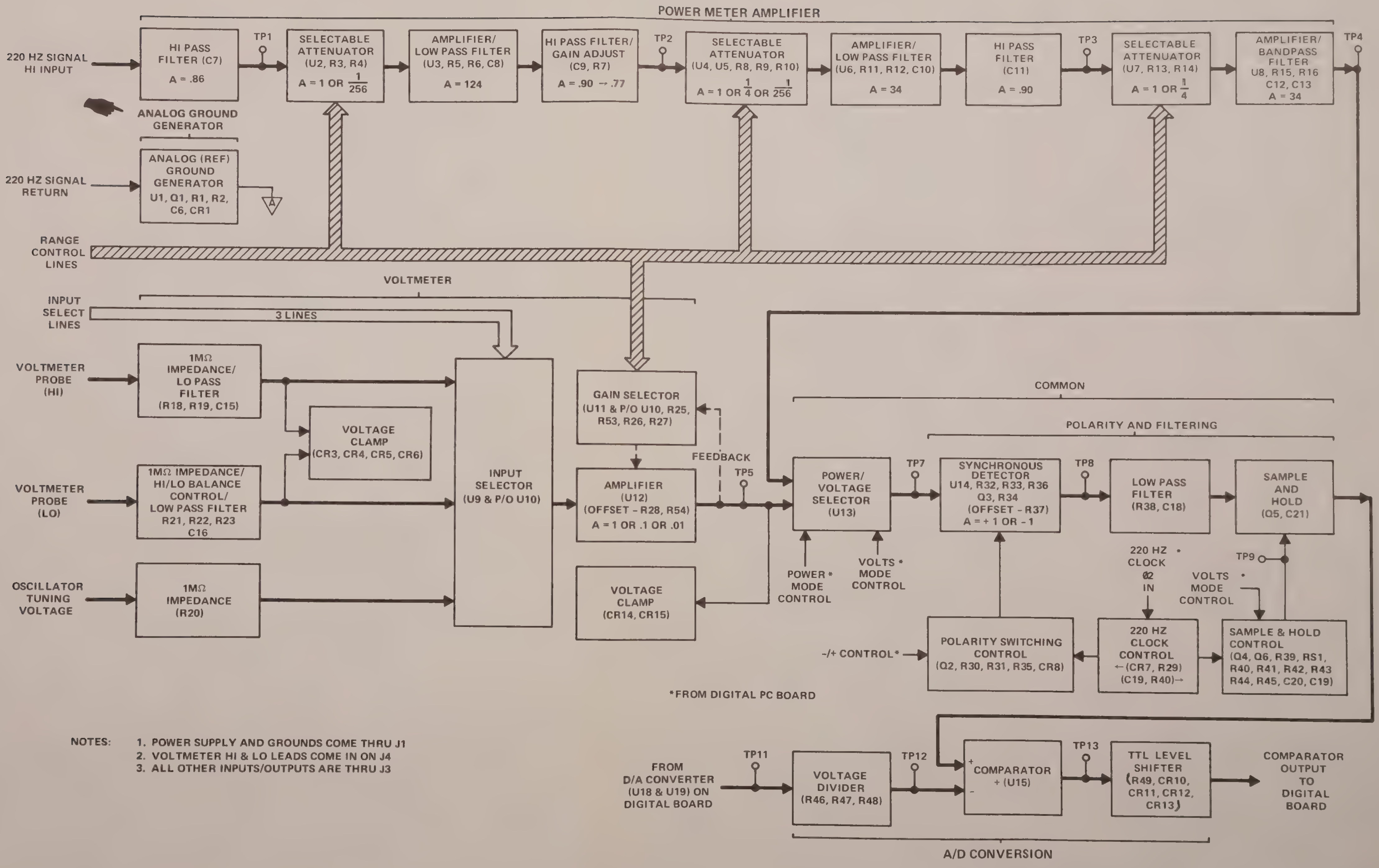
4.4.5.2. The Voltmeter section is used to select a voltage from either the "HI" or "LO" probe on the front panel or to select the oscillator tuning voltage from the digital PC board and to divide it down if necessary into a voltage readable by the common section.

4.4.5.2.1. All three inputs are connected through 1MΩ resistance and into the input selector. Additionally, the two voltmeter leads are clamped to prevent damage to the input selector.

4.4.5.2.2. The input selector is controlled by the digital PC board and switches one of the three voltages to the amplifier.

4.4.5.2.3. The amplifier's gain selector is in it's feed back path and is also controlled by the digital PC board. The three gain settings are given on the block diagram. The amplifier also has an offset control (R28). The output of the amplifier is connected to the common section of the PC board. A voltage clamp is used to avoid saturation while the unit is auto-ranging.

4.4.5.3. The common section selects which of the two input signals to process, changes the polarity of that signal as required, filters it and connects it to the comparator. This comparator is used in conjunction with a D/A converter on the digital PC board to convert this analog signal level into a digital number. All controlling inputs come from the digital PC board.


POWER METER AMPLIFIER
220 HZ SIGNAL HI INPUT
HI PASS FILTER (C7) A = .86
TP1
SELECTABLE ATTENUATOR (U2, R3, R4) A = 1 OR 1/256
AMPLIFIER/ LOW PASS FILTER (U3, R5, R6, C8) A = 124
HI PASS FILTER/ GAIN ADJUST (C9, R7) A = .90 → .77
TP2
SELECTABLE ATTENUATOR (U4, U5, R8, R9, R10) A = 1 OR 1/4 OR 1/256
AMPLIFIER/ LOW PASS FILTER (U6, R11, R12, C10) A = 34
HI PASS FILTER (C11) A = .90
TP3
SELECTABLE ATTENUATOR (U7, R13, R14) A = 1 OR 1/4
AMPLIFIER/ BANDPASS FILTER U8, R15, R16 C12, C13 A = 34
TP4
ANALOG GROUND GENERATOR
220 HZ SIGNAL RETURN
ANALOG (REF) GROUND GENERATOR U1, Q1, R1, R2, C6, CR1
A
RANGE CONTROL LINES
VOLTMETER
INPUT SELECT LINES
3 LINES
VOLTMETER PROBE (HI)
1MΩ IMPEDANCE/ LO PASS FILTER (R18, R19, C15)
VOLTAGE CLAMP (CR3, CR4, CR5, CR6)
VOLTMETER PROBE (LO)
1MΩ IMPEDANCE/ HI/LO BALANCE CONTROL/ LOW PASS FILTER R21, R22, R23 C16
OSCILLATOR TUNING VOLTAGE
1MΩ IMPEDANCE (R20)
INPUT SELECTOR (U9 & P/O U10)
GAIN SELECTOR (U11 & P/O U10, R25, R53, R26, R27)
FEEDBACK
AMPLIFIER (U12) (OFFSET – R28, R54) A = 1 OR .1 OR .01
TP5
VOLTAGE CLAMP (CR14, CR15)
COMMON
POLARITY AND FILTERING
POWER/ VOLTAGE SELECTOR (U13)
TP7
SYNCHRONOUS DETECTOR U14, R32, R33, R36 Q3, R34 (OFFSET – R37) A = + 1 OR – 1
TP8
LOW PASS FILTER (R38, C18)
SAMPLE AND HOLD (Q5, C21)
POWER * MODE CONTROL
VOLTS * MODE CONTROL
220 HZ * CLOCK Ø2 IN
TP9
VOLTS * MODE CONTROL
-/+ CONTROL*
POLARITY SWITCHING CONTROL (Q2, R30, R31, R35, CR8)
220 HZ CLOCK CONTROL ←(CR7, R29) (C19, R40)→
SAMPLE & HOLD CONTROL (Q4, Q6, R39, RS1, R40, R41, R42, R43 R44, R45, C20, C19)
*FROM DIGITAL PC BOARD
FROM D/A CONVERTER (U18 & U19) ON DIGITAL BOARD
TP11
VOLTAGE DIVIDER (R46, R47, R48)
TP12
+ COMPARATOR + (U15) -
TP13
TTL LEVEL SHIFTER (R49, CR10, CR11, CR12, CR13)
COMPARATOR OUTPUT TO DIGITAL BOARD
A/D CONVERSION

NOTES:
1. POWER SUPPLY AND GROUNDS COME THRU J1
2. VOLTMETER HI & LO LEADS COME IN ON J4
3. ALL OTHER INPUTS/OUTPUTS ARE THRU J3

Figure 4-15. Analog Board (A3) Block Diagram

4.4.5.3.1. The power/voltage selector passes either the sine wave from the power meter amplifier or the DC level from the voltmeter to the synchronous detector.

4.4.5.3.2. The synchronous detector has a gain of either +1 or -1 depending upon the state of polarity switching control. In power meter operation the effect of the synchronous detector is to rectify the sine wave. In voltmeter operation the synchronous detector inverts a negative input so that the voltage to the comparator is always positive.

4.4.5.3.3. The state of the polarity switching control is determined by the -/+ control input and the 220 Hz clock (Ø 2).

4.4.5.3.4. The output of the synchronous detector goes to the low pass filter which attenuates any high frequency noise on the signal. The output of the low pass filter goes to the sample and hold. In power meter operations the signal is sampled synchronously with the 220 Hz clock. This eliminates the 220 Hz ripple that is left after the low pass filter. This sampled signal is held by capacitor C21. In voltmeter operations the sample and hold is left on at all times. The output of the sample and hold goes to the comparator.

4.4.5.3.5. The sample and hold control receives its inputs from the 220 Hz clock and the Volts control line.

4.4.5.3.6. The voltage divider (÷4.5) reduces the voltage coming from the D/A converter (9V maximum) into a 2V maximum level to the inverting input of the comparator. The comparator output swings from +13V to -13V depending upon the relative levels of the voltage divider and the sample and hold outputs. The TTL level shifter converts this + or -13 Volt level to a +5 or 0 Volt level that is compatible with the TTL logic levels used by the digital PC board.

4.4.5.3.7. The analog to digital conversion technique using the comparator and D/A converter was covered in the discussion of the Digital PC board block diagram.

4.4.5.4. The analog ground generator (A GENERATOR) is used to reference all the analog path components to the same level. The input to the generator comes directly from the microwave detector via a non-current bearing line. The analog ground level generated is filtered from high frequency noise.

4.5. TROUBLESHOOTING.

Use the troubleshooting charts, Figure 4-16 and Figures 4-16-1 through 4-16-5, only after reviewing all information under paragraph 4.6. The troubleshooting charts will identify the defective PC board and in most cases will also identify the faulty section of the PC board. Additionally by noting the test being performed when the defective PC board is specified the technician has additional information available. As an example, suppose that by using the troubleshooting chart, it has been found that the 15V power supply is low. Further down the troubleshooting chart the analog board is found to be faulty. The technician would then be left on his own with the relatively simple task of finding the component on the analog board which goes to the 15V power supply and is loading it down. For a more complex fault the technician could also refer to paragraph 4.5.4 which gives pertinent PC board specifications and discusses specialized techniques (none of which require special fixtures) for isolating a defective component once the faulty PC board is known. For additional reference, the PC board's block diagrams under paragraph 4.4 could then be reviewed to determine the proper operation of each functional block and to identify components belonging to that block, as an aid in isolating a defective component.

4.5.1. Troubleshooting Features. The multimeter has two major built in features to facilitate troubleshooting. First, all I.C.'s are socket mounted instead of being soldered to the PC boards to facilitate troubleshooting by replacement and to eliminate the possibility of printed circuit board damage. Second, the multimeter goes through a self-check procedure whenever it is turned on. During I.C. removal the multimeter's power should be off. Use a CMOS safe extractor and place them in conductive foam.

NOTE

STATIC SENSITIVE DEVICES
CMOS devices have been used extensively in the multimeter. Standard anti-static procedures should therefore be employed whenever the unit is opened.

4.5.2. Self Check Program. When the multimeter is turned on the microprocessor first sends all true data to the front panel display section. This should turn on every segment of the LCD for approximately 5 seconds. A segment that does not turn on indicates a fault in either a shift register or the LCD. See Table 4-7 for a list of components and sections that can be eliminated as a cause of faulty operation, if the multimeter successfully completes its self check program.

4.5.2.1. After all true data has been sent to the LCD, the microprocessor checks each location in the RAM by writing data to it and reading the data back. Each address in RAM is checked numerous times. If an address fails, even once, an "E1" will be displayed on the LCD. This will indicate a problem in either the RAM or the RAM decoding sections.

4.5.2.2. If the RAM passes the test described under paragraph 4.5.1, the microprocessor next tests the EPROMS. EPROM 3 has a number stored near its highest address that is used in the test. The microprocessor reads data from each address in the EPROM's and performs certain predetermined mathematic operations with each one. A running total is kept. After all addresses have been read the final total is compared to the number mentioned in EPROM 3 to ensure that they are the same. If an error is determined in this portion of the test the microprocessor will send an "E2" to the LCD indicating a fault in either the EPROM(S) or the EPROM decoding section.

4.5.2.3 If the EPROM test is passed, the microprocessor next reads the minimum rated frequency of the microwave unit from that unit's cal PROM and displays it on the LCD. Next, the maximum rated frequency is read from the microwave unit's cal PROM and displayed on the LCD. A 7200 Series unit will display 0.00 and 10.00 corresponding to 0.00 and 10.00 tuning voltage. An improper display on the LCD indicates a problem in the microwave unit's cal PROM or decoding or in the interconnect cable. The microprocessor next reads and displays the setting of the bus address switch. If the bus interface is defective this number will not be displayed correctly*.

4.5.2.3.1. An improper display may also occur if an interrupt ($\overline{\text{IRQ}}$ or $\overline{\text{NMI}}$) is enabled during the self check program. However, a properly functioning interrupt will not be enabled during the self check. An interrupt could result in the LCD being left in the all segments on condition or in random changing states. The eliminate the possibility of an interrupt causing an improper display, jumper A2 TP1 ($\overline{\text{IRQ}}$) and A2 TP2 ($\overline{\text{NMI}}$) to A2 TP3 (+5V) and restart the unit by turning it off and on again, before definitely assigning the fault to the RAM or EPROM sections.

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*If the 7000A does not have Option -02 this test is not done by the microprocessor.

4.5.2.4. After the self-check is completed, the microprocessor sets the multimeter for voltmeter operation, indicated by the LCD display going to ".000 VOLTS." For units with the GPIB (Option-02) the REM is cleared and the multimeter is placed in local control. If the REM is not cleared there is a problem in either the IEEE-488 section or in its decoding. For unit without the GPIB option, depending on date of manufacture, the "REM" annunciator could be either on or off at this point. If the "REM" annunciator is on, pressing the VDC pushbutton will clear it. If the "REM" is still not cleared after pressing the VDC pushbutton, there is a problem in the IEEE-488 decoding (Option-02 units only) or the front panel display section. An indication of other than .000 ±.003 volts indicates a problem to be corrected by using the troubleshooting charts and appropriate block diagram information.

4.5.2.5. Defective I.C.'s can stop the self check program by holding a data or address line high or low. Problems of this type are isolated by scanning the address, data and control lines with an oscilloscope while looking for a line or lines that are not changing levels, have slow rise or fall times or some other feature significantly different from the other lines. I.C.'s can then be removed and reinstalled (with the power off) one at a time until the line or lines function normally with the power on and the replacement I.C. installed. When removing I.C.'s from their sockets use a grounded CMOS safe extractor and place them in conductive foam. Specialized techniques for this type of problem are covered under paragraph 4.5.4.

4.5.3. Control, Data and Address Lines in the Multimeter. Conventions used to describe the control, data and address lines in the multimeter are discussed in paragraphs 4.5.3.1 through 4.5.3.3.

4.5.3.1. Positive true logic is used (True ◊ $V \geq 2.4V$ False ◊ $V \leq .8V$) except for option -02 (IEEE-488 option), to name the lines. As an example:

4.5.3.1.1. D2 means data line 2 is true when at a voltage level of $\geq 2.4V$.

4.5.3.1.2. 220 Hz off means 220 Hz off signal is true when at a voltage level $\geq 2.4V$ (ie, it will turn the 220 Hz clock off when at a voltage level of $\geq 2.4V$).

4.5.3.1.3. Power. The power mode is selected when the power control line is at a voltage level of $\geq 2.4V$.

4.5.3.2. A bar over the name indicates that the named function is true when at a voltage level of $\leq .8V$. As examples:

4.5.3.2.1. $\overline{\text{EPROM3}}$ means EROM3 will be enabled to put data on the data bus when the $\overline{\text{EPROM3}}$ line is at a voltage level of $\leq .8V$.

4.5.3.2.2. $\overline{\text{IRQ}}$ means the microprocessor will respond to an interrupt request when the $\overline{\text{IRQ}}$ line is at a voltage level of $\leq .8V$.

4.5.3.2.3. $\overline{\text{RANGE CONT'L 3}}$ means RANGE3 is selected when $\overline{\text{RANGE CONT'L 3}}$ is at a voltage of $\leq .8V$.

4.5.3.3. The IEEE-488 standard programmable instrument interface bus lines are identified in the following paragraphs 4.5.3.3.1 and 4.5.3.3.2.

4.5.3.3.1. The input/output lines between J6 and the bus driver interface I.C.'s (U30 and U31) are identified by using the negative true conventions used in IEEE-488.

4.5.3.3.2. All other lines are identified by using the positive true convention discussed in paragraphs 4.5.3.1 and 4.5.3.2. One function of the MC 68488 GPIB adapter (U32) is to invert the logic levels of the data, handshake and bus management lines.

4.5.4. PC Board Troubleshooting Techniques. Refer to the following paragraphs for pertinent specifications and techniques for isolating a defective component after the system fault has been narrowed down to a PC board. Refer to Table 4-7 for a list of components and sections that can be eliminated as a cause of faulty operation if the multimeter successfully completes its self check program.

4.5.4.1. Power Supply (A4) PC Board for Model 7000A Multimeter and Associated Circuitry. Refer to Figure 6-1 in Section VI of this manual and note that except for AC line voltages the power supply specifications are the same for both A4 boards as indicated in Table 4-5.

4.5.4.1.1. For power supply (A4) PC board access/reconnect instructions, see Table 4-4.

4.5.4.1.2. Specialized Troubleshooting Techniques. None. This power supply is straightforward. It is not a switching type power supply nor does it use external voltage sensing. Thermal shutdown is done individually by the affected regulating I.C.

4.5.4.2. Power Supply (A4) PC Board for Model 7000A-01 (battery option) and Associated Circuitry. Refer to Figure 6-2 in Section VI of this manual and note that except for AC line voltages the power supply specifications are the same for both A4 boards as indicated in Table 4-5. The following specifications apply only to the A4 PC board for Model 7000A-01.

4.5.4.2.1. Fuse location on the A4 PC Board (105121). See reference designation F1 on Figure 6-2 in Section VI of this manual.

4.5.4.2.2. System Ground. The component side plating is the system ground, for the A4 (106121) PC board.

4.5.4.2.3. A4 PC Board (106121) Removal. Remove the connections (J1 and J4) to the digital and analog PC boards. Then remove the 4 screws from the corners of the A4 board. The board may now be tested.

4.5.4.2.4. Testing the A4 PC Board (106121). Use the DC input from the battery through J2 or connect J2 to a lab type power supply (V in - 11.5V ⟶ 14.0 V). The

Table 4-4

7000A A4 Board Access/Reconnect

STEP	ACTION
	ACCESS
1	Remove the four phillips head screws from the bottom surface of the multimeter (located in the feet).
2	Press down on the upper surface of the side bezel while carefully prying the top from the body, to avoid complete disassembly of the multimeter case.
3	With the multimeter open, unplug J1 and J2 (on the front panel) from A2J1 and A2J2.
4	Disconnect the analog meter wire from A3TP6 (front most test point).
5	Lift side bezel slightly to unplug voltmeter leads from A2J4.
6	Lift side bezels and two PC boards away from the A4 board, as a single unit.
	RECONNECT
1	Reconnect A3P1 to A4J1. Route these two ribbon cables through the opening provided for this purpose, at the right rear side of the unit.
2	Plug voltmeter lead to A3J4.
3	Reassemble side bezel to front panel assembly. The voltmeter lead, P1 and P2 ribbon connectors and analog meter lead, should be positioned forward and up.
4	Reconnect A4P4 to A2J4.
5	Reconnect J1 from front panel to J1A2 and J2 from front panel to J2A2.
6	Reconnect analog meter wire to A3TP6 (front most test point).
7	Replace top cover assembly. Hold bezel and front panel assemblies together as a single unit with hand pressure. Flip the unit over and install the four feet with associated screws and hex nuts.

NOTE

These instructions do NOT apply to 7000A-01 because the A4 board for that model is readily accessible. It is located on top, directly behind the analog (A3) PC board.

Table 4-5
Power Supply PC Board Specifications

Nominal line voltage for 7000A PC Board 105650: 100, 120, 220, 240 volts (selectable at the rear panel of the multimeter).

Nominal Line Voltage for 7000A-01 (battery option) PC board 106121: 115, 230 Volts (selectable on CP1). AC Input: +10% - 6% of the selected nominal line voltage.

Operational Line Frequency: 47 to 440 Hz.

POWER SUPPLY	V out	I out	RIPPLE	LOAD REGULATION	LINE REGULATION
+5V	5.2 → 4.6V	1.0 A	100 mV p-p	130 mV	100 mV
+15V	15.6 → 14.4V	100 mA	50 mV p-p	50 mV	50 mV
-15V	-15.6 → 14.4V	100 mA	50 mV p-p	50 mV	50 mV
V BIT	12.5 → 11.4V	500 mA	100 mV p-p	150 mV	150 mV
+40 V	52 → 38 V	5 mA	1 V p-p	-	-

NOTES

1. As indicated in the PC board block diagram discussion under paragraph 4.4, the supplies are straight forward. No external sensing or current feedback is used.

2. The supplies listed here are used to supply biasing currents only. The only critical levels in the Model 7000A multimeter are the analog ground (▽A) generated on the analog PC board (A3) and the VREF (-9.0V ± 5%) generated on the digital PC board (A2). V ref is very stable over time and temperature, and the absolute value of VREF is compensated for during system calibration.

maximum current draw if all supplies (except V Bat.) are fully loaded should be 1.5A. V Bat is a direct connection from F1 to J4 and therefore only requires a continuity check.

4.5.4.3. Digital (A2) PC Board. Refer to Figure 6-3 in Section VI of this manual for specifications and see Table 4-6 for an explanation of abbreviations used in the schematic.

4.5.4.3.1. If the digital (A2) PC board has a probelm that does not allow the multimeter to successfully complete its self check program, review and follow procedures listed under paragraph 4.5.2 before proceeding. If the multimeter successfully completes its self check program, refer to Table 4-7 for a list of components and sections that can be eliminated as causing faulty operation. Then, proceed as indicated in paragraph 4.5.4.3.5.

4.5.4.3.2. To eliminate the possibility that the front panel interrupt and decoding section is causing the fault, turn off the power and connect TP1 ($\overline{\text{IRQ}}$) to TP3 (+5). Then, using a grounded CMOS safe extractor remove U5 and U6 from their sockets and place them in conductive foam. Next, turn the power back on. If the multimeter now successfully completes its self check program, this section or its decoding ($\overline{\text{IN0}}$ and $\overline{\text{IN1}}$) is at fault.

4.5.4.3.3. To eliminate the possibility that the IEEE-488 section of a multimeter with option -02 installed is at fault, proceed as follows: turn off the power and using a grounded CMOS safe extractor remove U32 from its socket and place it in conductive foam. Next, turn the power back on. If the multimeter now successfully completes its self check program, this section or its decoding ($\overline{\text{GPIB}}$) is at fault.

4.5.4.3.4. To eliminate the possibility that the section controlled through the PIA may be at fault, proceed as follows: turn off the power and using a grounded CMOS safe extractor remove the D/A converters and latching buffers (U17, U19, U20, U21 and U24) from their sockets and place them in conductive foam. Make sure that each D/A converter is returned to its own I.C. socket. Next, turn the power back on. If the multimeter now successfully completes its self check program, this section or its decoding (PB Bus) is at fault.

NOTE

> Although these I.C.'s are controlled through the PIA and are therefore buffered from the microprocessor's address data and control busses so that they cannot cause an indicated fault of "E1" or "E2", they may cause a different problem with the display if the PA0 (data in) or PB6 (shaft clk) lines are affected.

Table 4-6

Digital (A2) PC Board Schematic Abbreviations

ABBREVIATION	FULL NAME	DESCRIPTION	FUNCTION
MPU	Microprocessor	Integrated Ckt	See block diagram discussion
PIA	Peripheral Interface Adapter	Same	Same
RAM	Random Access Memory	Same	Same
EPROM	Erasable Programmable Read Only Memory	Same	Same
D/A	Digital to Analog Converter	Same	Same
$\overline{\text{IRQ}}$	Interrupt Request (not)	μρ control	Interrupts ongoing program - MPU will search for what generated the $\overline{\text{IRQ}}$ and go to the new program (mode). Available at TP1.
$\overline{\text{NMI}}$	Non Maskable Interrupt (not)	Same	Used to time measurements involving the microwave detector. Availabe at TP2.
$\overline{\text{HALT}}$	Halt (not)	Same	Stops the program. When released, the program will continue from where it stopped. Not used in normal operation. $\overline{\text{HALT}}$ is available at TP7 as a trouble-shooting aid.
$\overline{\text{RESET}}$	Reset (not)	Same	Causes MPU to restart main program as if unit were just turned on. Not used. Should be at +5V.
RAMEN	Random Access Memory Enable	Same	Enables MPU's internal RAM. Not used.

Table 4-6 (Cont)

ABBREVIATION	FULL NAME	DESCRIPTION	FUNCTION
VMA	Valid Memory Address	μρ Control	Indicates to RAM(S) and EPROM(S) that there is a valid address on the address bus. Used in memory decoding.
BA	Bus Available	Same	Not used.
MR	Memory Refresh	Same	Not used.
R/$\overline{\text{W}}$	Read/Write (not)	Same	Indicates to RAMS, EPROMS and PIA whether MPU is in read or write mode.
ENABLE	Data Bus Enable	Same	The enable line is a 1 MHz clock driven by the 4 MHz clock, which synchronizes the data bus.
4.00 MHz	4.00 MHz clock		Synchronizes the MPU for all operations
A0 - A15	Address lines 0 → 15	Bus	Address Bus
D0 - D7	Data Lines 0 → 7	Bus	Data Bus.
PA0 - PA7	Peripheral Interface Adapter Data Bus	Bus	PIA Data Bus, when enabled has same data as D0 - D7.
PB0 - PB7	Peripheral Interface Adapter Decoding and Control Bus	Bus	PIA Decoding and Control Output Bus, when enabled, has same data as D0 - D7.
$\overline{\text{EPROM 0 - 3}}$	EPROM 0 - 3 (not)	Decoding	Enables the selected EPROM
$\overline{\text{CALPRM}}$	Calibration Prom (not)	Decoding	Enables the calibration prom in the microwave unit.
$\overline{\text{GPIB}}$	General Purpose Interface Bus (not)	Decoding	Enables the IEEE 488 option

Table 4-6 (Cont)

ABBREVIATION	FULL NAME	DESCRIPTION	FUNCTION
$\overline{\text{IN0}}$	Input 0 (not)	Decoding	Enables the Front Panel Pushbutton buffer (U5)
$\overline{\text{IN 1}}$	Input 1 (not)	Decoding	Enables the Front Panel Pushbutton buffer (U6)
OUT 0 (PB0)	Output 0	Decoding	Enables the Output Latching Buffer (U20)
OUT 1 (PB1)	Output 1	Decoding	Enables the Output Latching Buffer (U17)
CS-	Chip Select -	Decoding	Enables the I.C.
ADC 1H (PB2)	D/A Converter #1 High BITS	Decoding	Enables D/A converter (U19) to load in Data for the 2 higher BITS. Used for analog to digital conversion.
ADC 1L (PB3)	D/A Converter #1 Low BITS	Decoding	Enables D/A Converter (U19) to load in Data for the 8 lower BITS. Used for analog to digital conversion.
ZRO H (PB4)	Zeroing D/A Converter High BITS	Decoding	Enables the D/A converters (U21 and U24) to load in Data for the 2 higher BITS. Note that U24 also requires an output from latching buffer (U17).
ZRO L (PB5)	Zeroing D/A Converter Low BITS	Decoding	Enables the D/A converters (U21 and U24) to load in Data for the two lowest Bits. Note that U24 also requires an output from latching buffer (U17).
+/- control	+/- control	Analog Board Control Outputs	Controls polarity of signal to analog board's comparator.

Table 4-6 (Cont)

ABBREVIATION	FULL NAME	DESCRIPTION	FUNCTION
PWR	Power	Analog Board Control Outputs	Sets analog board switches for power mode.
VOLT	Voltage	Same	Sets analog board switches for Voltmeter mode.
VDC HI	Volts DC High Probe	Same	Sets analog board to read voltage on the high probe.
VDC LO	Volts DC Low Probe	Same	Sets analog board to read voltage on the low probe.
V TUNE CONT'L	V Tune Control	Same	Sets analog board to read the frequency tuning voltage.
$\overline{\text{RANGE CONT'L 1 - 7}}$	Range Control 1 - 7 (not)	Same	Sets the measurement range on the analog board in both Power and Voltage modes.
SHIFT CLK (PB6)	Shift Clock	Analog and Miscellaneous Signals	Provides synchronizing pulse train to Front Panel display section.
COMP OUT (PB7)	Comparator Output	Same	Generated on analog board (A3). Provides data about the relative levels of the processed signal and the programmed D/A output voltage.
DATA IN (PA0)	Data Input	Same	Provides data for the Front Panel Display section when SHIFT CLK pulse train is present. Otherwise, is used as the LSB of the PIA Data Bus.

Table 4-6 (Cont)

ABBREVIATION	FULL NAME	DESCRIPTION	FUNCTION
V REF	Reference Voltage	Analog and Miscellaneous Signals	Provides the reference voltage to the D/A converters i.e., The only reference voltage for the entire multimeter.
RESET	Reset	Same	Resets the counter on the $\overline{\text{NMI}}$ generator.
220 Hz OFF	220 Hz clock off	Same	Turns 220 Hz clock off. NOTE: 5V ⟶ off, 0V ⟶ On.
Ø2	220 Hz Clock Ø2 Output	Same	1. Provides a modulating signal for the microwave detector's chopper. 2. Provides the demodulating signal for the analog board's Synchronous Detector. 3. Provides the input for the $\overline{\text{NMI}}$ Generator A) Ø2 is a 0 to -15V square wave when enabled. B) Ø2 is available at TP4. C) Ø2 is at 0V when not enabled.
Ø1	220 Hz Clock Ø1 Output	Same	Provides a modulating signal for the Microwave Detector's Chopper. A) Ø1 is a 0 to -15V square wave when enabled. B) Ø1 is 180° out of phase with Ø2 when enabled. C) Ø1 is at 0V when not enabled.
OSC OFF	Oscillator Off	Same	Provides a controlling signal to turn off the Microwave Unit's source.

Table 4-6 (Cont)

ABBREVIATION	FULL NAME	DESCRIPTION	FUNCTION
OSC TUNE	Oscillator Tuning Voltage	Analog and Miscellaneous Signals	Generated in two places 1. D/A Converter (U21) 2. Front panel Tune Pot Both go to the Frequency Control Select Switch (U16); See V TUNE. NOTE that OSC Tune is a DC level from 0 to 10V.
V TUNE	Oscillator Tuning Voltage	Same	V TUNE is the output of U16. It is used to tune the frequency of the microwave units source. NOTE that V Tune is a DC level from 0 to 10V.

Table 4-7

Known Good Components and Sections After Successful Self Check

ITEM	DESCRIPTION
1	Microprocessor (except for $\overline{\text{IRQ}}$ and $\overline{\text{NMI}}$ inputs)
2	RAM and RAM decoding
3	EPROMS and EPROM deocoding
4	Part of the PIA - decoding, control lines, data lines, (D0 - D7), and PB6 lines
5	4 MHz clock
6	IEEE-488 decoding
7	Cal PROM decoding and the digital lines in interconnect cable W1
8	Front panel display section
9	5V power supply

4.5.4.3.5. The following procedures all pertain to multimeters that have successfully completed the self check program. Before starting, check that V Ref, A2TP5 is -9.0V ± 5% and that ▽A and ▽0 are within 25 mV of ⏚.

4.5.4.3.6. The $\overline{\text{HALT}}$ line (A2TP7) may be used whenever steady state signal levels are desired, by connecting A2TP7 to ground (⏚). This is particularly useful when checking gates, inverting buffers, etc. or when checking that the range and mode setting outputs of the board are at their expected levels. When the ground is removed from A2TP7 the multimeter will continue the program from where it stopped.

4.5.4.3.7. The $\overline{\text{NMI}}$ line (A2TP2) is most useful for checking the operation of the 220 Hz clock and $\overline{\text{NMI}}$ generator. It may be used like the $\overline{\text{HALT}}$ line for measurements involving the microwave detector. When the multimeter is making a measurement involving the microwave detector the microprocessor sets all the output and range lines, turns on the 220 Hz clock and resets the $\overline{\text{NMI}}$ generator. It then waits for the $\overline{\text{NMI}}$ signal before proceeding to the next step. (The next step would be to stop the sample and hold circuit on the analog board and then to do the analog to digital conversion routine to determine the analog signal level.) If the $\overline{\text{NMI}}$ (A2TP2) line is jumpered to +5V (A2TP3) then the microprocessor will never receive its signal to continue. The technician may now check the Ø1 and Ø2 outputs of the 220 Hz clock, the counter output (A2 U 28, pin 6) to see that a pulse is present every 450 mSec., the outputs to analog board (A3) and the outputs to the microwave unit while they are steady state.

4.5.4.3.8. To verify proper operation of the PIA, D/A converter (U19, U21 and U24) and buffers (U18, U25 and U27), press $\boxed{\text{2nd}}$ and $\boxed{\text{SWEEP GEN}}$ and connect the "SWEEP OUT" BNC connector at the rear panel of the multimeter to the vertical input of an oscilloscope. The oscilloscope presentation should be as shown in Figure 4-9. The sweep should start at 0.00V ±30 mV and have a max voltage = V Ref ±1%.

CAUTION

When removing I.C.'s U18, U19, U21, U24, U25 or U27 make careful note of which I.C. came from which socket. Replacing them in different positions will require recalibration.

4.5.4.3.8.1. A momentary flicker on the display will occur as the front panel LCD is updated. If the presentation is not correct, turn off the power, label the D/A converters and their buffer OP AMPS. Then, remove the other two D/A converters (U21 and U24) and the latching buffers (U17 and U2) from their sockets, using a grounded CMOS safe extractor and place them in conductive foam. Replace U18 with U25. When this test is completed be sure to replace the I.C.'s in their original sockets. If you lose track of which I.C. is U21, recalibrate the

V tune section using the procedure called out under paragraph 4.2.5. If you lose track of which I.C. is U19, recalibrate the voltmeter section, using the procedure called out under paragraph 4.2.3.

4.5.4.3.8.2. Turn the multimeter power on and press 2nd and SWEEP GEN . If the presentation is now correct, the problem is in one of the I.C.'s that were removed. Replace them one at a time with the power off and then on to identify the faulty component.

4.5.4.3.8.3. This technique may be used to check out the other two D/A converters and their buffers by placing them in the U19 and U18 sockets and re-running the test. In effect, the 7000A has a built in D/A converter/buffer test fixture.

4.5.4.3.8.4. If the display is not correct for any of the D/A converters, the problem is in the PIA.

4.5.4.3.8.5. In every mode other than the sweep generator, the output of U19 is used in the A/D conversion routine. The final output, which is kept constant until the next A/D conversion should be 4.5 times the voltage of the + input of the comparator on the analog (A3) board. This signal is always available at the "SWEEP OUT" BNC connector and can be used as an additional test point.

4.5.4.3.9. To verify proper operation of the front panel interrupt and decoding section, connect a scope probe to A2TP1 ($\overline{\text{IRQ}}$) and then press every front panel control one at a time. Whenever a control is pressed, A2TP1 should go low and stay low until the control is released, regardless of the position of the "SINGLE FREQ/ AUTO STEP" switch. Switching from "AUTO STEP" to "SINGLE FREQ" should cause A2TP1 to only momentarily go low. Switching from "SINGLE FREQ" to "AUTO STEP" should cause A2TP1 to remain high (no change).

4.5.4.3.9.1. If A2TP1 responds correctly to this test and the multimeter does not change to the selected mode of operation, the problem is in A2U5 or A2U6. Use the schematic to determine which I.C. is used for the non-operating mode, (VDC button goes to U6, VSWR button goes to A2U5, etc.).

4.5.4.3.9.2. If A2TP1 does not respond correctly, isolate the defective component by tracing the signal back, starting with A2U3.

4.5.4.4. Front Panel (A1) PC Board. Refer to Figure 6-4 in Section VI of this manual and note that discussion of this board is divided into two parts. The first, discussed under 4.5.4.4.1 covers the display section. The second, discussed under 4.5.4.4.2 covers the control section.

4.5.4.4.1. Display Section. The 30 Hz clock (A1U4) should be on whenever the multimeter is on. A 30 Hz square wave of approximately 5V peak to peak should be present at A1J4 pin 11.

4.5.4.4.1.1. To isolate the fault at a segment that is always on or always off, turn off the power and using a grounded CMOS safe extractor, swap shift registers A1U2 and A1U3. If the problem segment moves, the fault is in the shift register (see schematic for pin outs). If the same segment is still non-functional, the problem is in the LCD or the I C. sockets for the LCD shift register. (Use an ohmmeter to check continuity of the segment in question with A1U2, A1U3 and the LCD removed. Applying DC voltage from the ohmmeter across LCD segments can permanently damage the LCD).

4.5.4.4.1.2. In voltmeter mode the waveforms at A1U2 pin 39 (shift clk) will be a pulse train consisting of 48 pulses (0 → 5V) repeated at approximately one second intervals. Each pulse will be approximately 6 µsec. in duration with a pulse repetition time of approximately 25 µsec. After every 8th pulse the pulse repetition time will be approximately 50 µsec. The waveform at A1U2 pin 2 (data in), during the shift clk. pulse train, will be the same except that some of the pulses will be missing. Synchronize the oscilloscope with the shift clk line when observing the data line.

4.5.4.4.2. Control Section. When a button is pressed its output line should go to ground. When the button is no longer pressed, the line should go to +5V.

4.5.4.4.2.1. To determine that front panel controls are interrupting the microprocessor correctly, connect a scope probe to A2TP1 ($\overline{\text{IRQ}}$). When no controls are pressed the $\overline{\text{IRQ}}$ line should be high. When a control is pressed the $\overline{\text{IRQ}}$ line should go low and remain low for as long as the control is held down. When "SINGLE FREQ" is selected the $\overline{\text{IRQ}}$ line should momentarily go low and then return to high. If the $\overline{\text{IRQ}}$ line is functioning properly, the fault is in the digital (A2) board and not in the front panel (A1) board.

4.5.4.4.2.2. To check the "TUNE" control, connect a scope probe or voltmeter to A1E3. With the "TUNE" control fully counterclockwise the voltage at A1E3 should be 0V. When the "TUNE" control is fully clockwise the voltage at A1E3 should be between 10.0 and 11.2 volts. As the "TUNE" control is rotated the voltage should rise evenly without sudden jumps or dead spots.

4.5.4.5. Analog (A3) PC Board. Refer to Figure 6-5 in Section VI of this manual and check that the output of the analog ground (Ⓐ) generator (emitter of A3Q1) is within 25 mV of the chassis ground (⏚). The mount return input to the Ⓐ generator goes through the digital (A2) PC board and the microwave unit's PC board and connects to the microwave detector's subassembly at the detector only. If the microwave unit is disconnected from the multimeter, R50 keeps Ⓐ to within 25 mV of ⏚. Make all voltage measurements with the low lead of your DVM on Ⓐ.

4.5.4.5.1. The following paragraphs pertain to the voltmeter section of the analog board. Because of the operational flow of events (as described in Section III of this manual) by which the multimeter measures voltages, they normally will be continually changing. To obtain steady state measurements, proceed as follows:

4.5.4.5.1.1. Ground the $\overline{\text{HALT}}$ line (TP7) on the digital (A2) PC board. Using the $\overline{\text{HALT}}$ line, the technician may evaluate the voltages in the voltmeter section (and common section if desired) in a steady state, then momentarily release the $\overline{\text{HALT}}$ line and evaluate them again. The multimeter will first read the "HI" probe, then auto range, change polarity if required, then read the "LO" probe the same way. The polarity change is made in the common section.

4.5.4.5.1.2. For input voltages ≤ 2.0V, the voltmeter section should be in the X1 range ($\overline{\text{X1}}$ should be low) and the voltage at A3TP5 should be equal to the input voltage magnitude and of opposite polarity.

4.5.4.5.1.3. For input voltages between 2V and 20V, the $\overline{\text{X0.1}}$ line should be low (≤ .8V) and V @ A3TP5 should equal -Vin/10.

4.5.4.5.1.4. For input voltages greater than 20V, V @ A3TP5 should be equal to -Vin/100 and the $\overline{\text{X.01}}$ line should be low.

4.5.4.5.2. The following paragraphs pertain to the power meter amplifier section of the analog board. When testing the power meter section refer to Table 4-8 and proceed as follows:

4.5.4.5.2.1. Jumper the $\overline{\text{NMI}}$ signal (A2 TP2) to +5V (A2 TP3) to obtain steady state waveforms. Wait several seconds after changing input power levels before adding the jumper so that the multimeter can autorange.

4.5.4.5.2.2. The expected waveforms for an input power to the microwave detector of approximately -2 dBm are shown in Figure 6-5 in Section VI of this manual. To

Table 4-8
Input Power Versus Attenuator Setting

INPUT POWER LEVEL	RANGE	$\overline{\text{RANGE CONT'L}}$ LINES TRUE	GAIN OF SELECTABLE ATTENUATORS		
(dbm)	-	$V \leq 0.8V$	#1	#2	#3
+13 → +4	1	1, 5, 6	÷256	÷256	÷4
+4 → -15	2	1, 5, 7	÷256	÷256	÷1
-15 → -21	3	1, 4, 6	÷256	÷4	÷4
-21 → -27	4	2, 5, 6	÷1	÷256	÷4
-27 → -38	5	2, 5, 7	÷1	÷256	÷1
-38 → -50	6	2, 4, 6	÷1	÷4	÷4
-50 → ∞	7	2, 3, 6	÷1	÷1	÷4

NOTES:

1. Because the curve of V out versus Pwr in varies from detector to detector, the power levels range changes will occur at will vary ±1 db from unit to unit. This will not affect system accuracy.
2. As in any auto-ranging system, the input levels that will cause range switching will change slightly, depending upon whether the switching is from a higher to a lower range or from a lower to a higher range. This will not affect indicated power.
3. The switching levels given in this table are for increasing power.

adjust for the exact test conditions, perform the steps in their given order as listed in Table 4-9.

Table 4-9

Input Power Waveform Test

STEP	ACTION
1	Zero the power meter and press CONT after "dut" appears on the LCD.
2	Set the power input level to -2 dBm.
3	Wait several seconds for the multimeter to auto range.
4	Jumper A2 TP2 to A2 TP3 (digital PC board).
5	Jumper A3 TP12 to A3 TP13 (analog PC board).
6	Adjust the "CAL" pot. on the microwave unit for exact phasing at TP8.
7	Adjust the input power for a 1.00V level at TP13.
8	Synchronize the scope trace to A2 TP4 (Ø2) so that the trace starts when Ø2 goes to 0V.
9	Before returning the multimeter to service, recalibrate the "CAL" pot on the microwave unit.

NOTE:

As the "CAL" pot. on the microwave unit is adjusted, the phasing at TP8 will shift slightly. Because the amplifier is linear however, this will not cause any inaccuracies.

4.5.4.5.3. The following paragraphs pertain to the common section of the analog board.

4.5.4.5.3.1. The 220 Hz clock is a steady state 0V, and the +/- control logic state changes to change the analog signal polarity to the comparator, during voltmeter mode.

4.5.4.5.3.2. The +/- control is at 0V and the 220 Hz clock controls polarity during power meter mode.

4.5.4.5.3.3. The sample and hold circuit is always on (V @ TP9 $\geq$ 0V) during voltmeter mode.

4.5.4.5.3.4. The sample and hold circuit is enabled in sync with the 220 Hz clock during power meter mode.

4.5.4.5.3.5. See Figure 6-5 in Section VI of this manual for expected wave forms in power meter mode.

4.5.4.5.3.6. The voltage at TP11 (from D/A) is also available at the "SWEEP OUT" BNC connector on the multimeter's rear panel.

4.6. USING THE TROUBLESHOOTING CHART.

Do not start any troubleshooting procedure before reading the following paragraphs. Compliance may prevent damage to the multimeter while saving time. Names of function blocks found on the troubleshooting chart are the same names used in the block diagrams and on the PC boards.

4.6.1. General Practice. When troubleshooting the multimeter the following general practices apply:

4.6.1.1. Use standard anti-static procedures whenever the multimeter is opened. CMOS components are on every PC board except the power supply.

4.6.1.2. Turn system power off before removing an I.C. or disconnecting a cable.

4.6.1.3. When removing I.C.'s from their sockets, use a grounded CMOS safe extractor and place them in conductor foam.

4.6.1.4. The multimeter should be connected to a good earth ground.

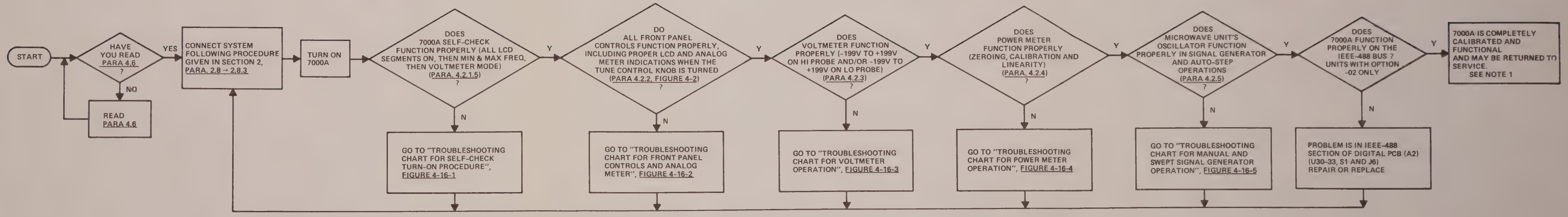
4.6.1.4.1. The Model 7000A is grounded through the power cord. Do not connect the multimeter unless a good third wire ground is available.

4.6.1.4.2. Model 7000A-01 (battery option) has a terminal marked ⏚ , located on the rear panel that should be connected to an earth ground.

4.6.2. Troubleshooting Chart Organization. One master chart is used to divide the entire troubleshooting procedure into six branch charts which contain related tests. This allows systematic elimination of the multimeter's various subystems and functional blocks as the area causing the fault, so that defective components can be more readily isolated.

4.6.2.1. Perform the tests on the master chart until the first block describing the system fault is encountered. The master chart will then direct the technician to the appropriate branch chart.

4.6.2.2. Each of the five branch charts will allow the fault to be isolated to a PC board or functional block of a PC board. Additionally, each branch chart contains a list of assemblies and functional blocks that are known to be good because of tests done prior to starting work described on that particular branch chart along with a list of known good functional blocks which are checked off as the technician works through the chart and encouters the referenced letter.


START
HAVE YOU READ PARA 4.6 ?
YES
NO
READ PARA 4.6
CONNECT SYSTEM FOLLOWING PROCEDURE GIVEN IN SECTION 2, PARA. 2.8 → 2.8.3
TURN ON 7000A
DOES 7000A SELF-CHECK FUNCTION PROPERLY (ALL LCD SEGMENTS ON, THEN MIN & MAX FREQ, THEN VOLTMETER MODE) (PARA. 4.2.1.5) ?
Y
N
GO TO "TROUBLESHOOTING CHART FOR SELF-CHECK TURN-ON PROCEDURE", FIGURE 4-16-1
DO ALL FRONT PANEL CONTROLS FUNCTION PROPERLY, INCLUDING PROPER LCD AND ANALOG METER INDICATIONS WHEN THE TUNE CONTROL KNOB IS TURNED (PARA 4.2.2, FIGURE 4-2) ?
Y
N
GO TO "TROUBLESHOOTING CHART FOR FRONT PANEL CONTROLS AND ANALOG METER", FIGURE 4-16-2
DOES VOLTMETER FUNCTION PROPERLY (-199V TO +199V ON HI PROBE AND/OR -199V TO +199V ON LO PROBE) (PARA 4.2.3) ?
Y
N
GO TO "TROUBLESHOOTING CHART FOR VOLTMETER OPERATION", FIGURE 4-16-3
DOES POWER METER FUNCTION PROPERLY (ZEROING, CALIBRATION AND LINEARITY) (PARA. 4.2.4) ?
Y
N
GO TO "TROUBLESHOOTING CHART FOR POWER METER OPERATION", FIGURE 4-16-4
DOES MICROWAVE UNIT'S OSCILLATOR FUNCTION PROPERLY IN SIGNAL GENERATOR AND AUTO-STEP OPERATIONS (PARA 4.2.5) ?
Y
N
GO TO "TROUBLESHOOTING CHART FOR MANUAL AND SWEPT SIGNAL GENERATOR OPERATION", FIGURE 4-16-5
DOES 7000A FUNCTION PROPERLY ON THE IEEE-488 BUS ? UNITS WITH OPTION -02 ONLY
Y
N
PROBLEM IS IN IEEE-488 SECTION OF DIGITAL PCB (A2) (U30-33, S1 AND J6) REPAIR OR REPLACE
7000A IS COMPLETELY CALIBRATED AND FUNCTIONAL AND MAY BE RETURNED TO SERVICE. SEE NOTE 1

NOTES:

1) BY PERFORMING THE THREE ADDITIONAL TESTS LISTED BELOW WHICH ARE DESCRIBED IN THE MICROWAVE UNITS MANUAL, THE MICROWAVE UNIT WILL ALSO BE COMPLETELY CALIBRATED:

   1. TEST PORT OUTPUT POWER LEVEL TEST
   2. INSERTION LOSS TEST
   3. REFLECTION MEASUREMENT TEST

2) ALL BRANCH TROUBLESHOOTING CHARTS RETURN TO THE BEGINNING OF THE MASTER CHART TO INSURE THAT WHEN ONE SECTION WAS REPAIRED ANOTHER SECTION WAS NOT INADVERTENTLY DAMAGED.

Figure 4-16. Master Troubleshooting Chart

FUNCTIONAL BLOCKS KNOWN GOOD FROM PRIOR TESTS	KEY	FUNCTIONAL BLOCK JUST CHECKED - O.K.
NONE	Ⓐ	+5V POWER SUPPLY (AND DISTRIBUTION
	Ⓑ	1) 4 MHZ CLOCK (A2) 2) RAM & RAM DECODING (A2)
	Ⓒ	1) EPROM & EPROM DECODING (A2) 2) MICROPROCESSOR (EXCEPT $\overline{\text{IRQ}}$ & $\overline{\text{NMI}}$) (A2)
	Ⓓ	1) CAL PRM DECODING DIGITAL LINES IN W1 (MICROWAVE UNIT) 2) PART OF PIA - DECODING, CONTROL LINES, D0-D7, PAO-PB6 3) FRONT PANEL DISPLAY SECTION

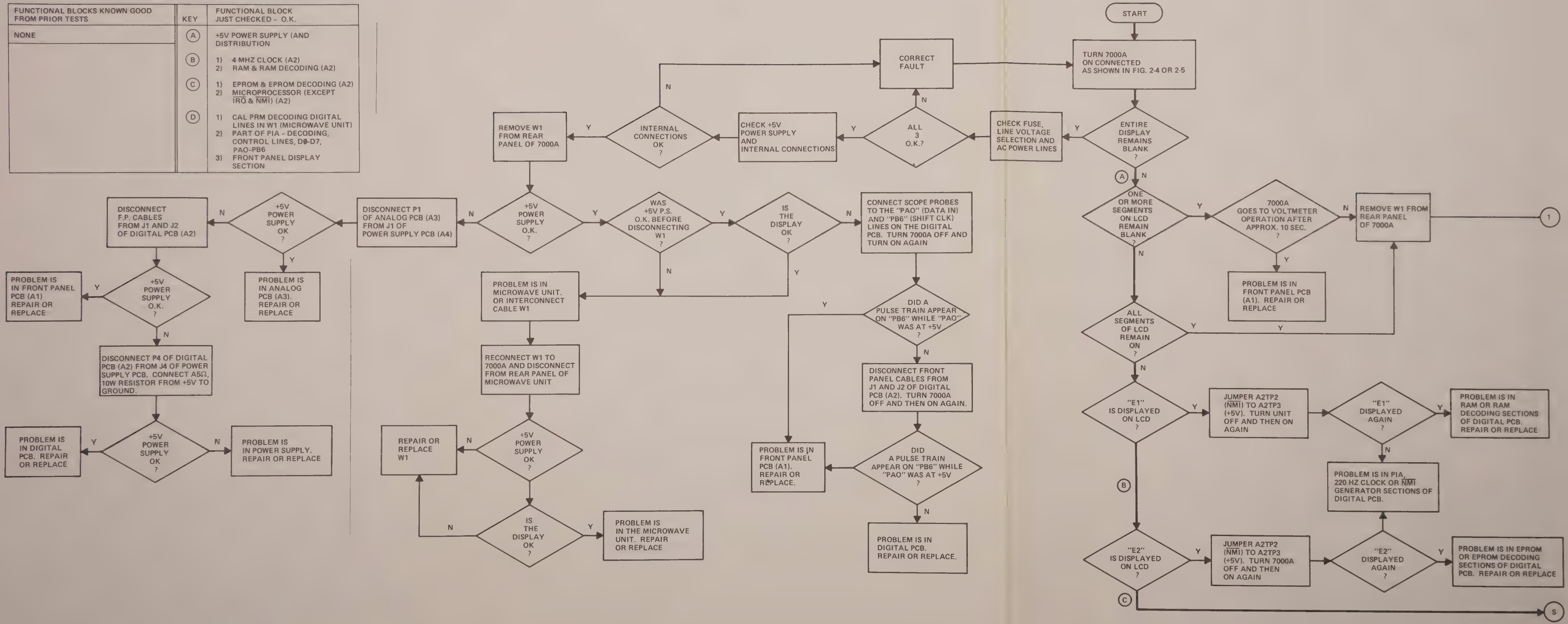

START
TURN 7000A ON CONNECTED AS SHOWN IN FIG. 2-4 OR 2-5
ENTIRE DISPLAY REMAINS BLANK ?
Y
CHECK FUSE, LINE VOLTAGE SELECTION AND AC POWER LINES
ALL 3 O.K.?
N
CORRECT FAULT
Y
CHECK +5V POWER SUPPLY AND INTERNAL CONNECTIONS
INTERNAL CONNECTIONS OK ?
N
Y
REMOVE W1 FROM REAR PANEL OF 7000A
+5V POWER SUPPLY O.K. ?
Y
WAS +5V P.S. O.K. BEFORE DISCONNECTING W1 ?
Y
IS THE DISPLAY OK ?
N
CONNECT SCOPE PROBES TO THE "PAO" (DATA IN) AND "PB6" (SHIFT CLK) LINES ON THE DIGITAL PCB. TURN 7000A OFF AND TURN ON AGAIN
DID A PULSE TRAIN APPEAR ON "PB6" WHILE "PAO" WAS AT +5V ?
Y
N
DISCONNECT FRONT PANEL CABLES FROM J1 AND J2 OF DIGITAL PCB (A2). TURN 7000A OFF AND THEN ON AGAIN.
DID A PULSE TRAIN APPEAR ON "PB6" WHILE "PAO" WAS AT +5V ?
PROBLEM IS IN FRONT PANEL PCB (A1). REPAIR OR REPLACE.
N
PROBLEM IS IN DIGITAL PCB. REPAIR OR REPLACE.
Y
N
PROBLEM IS IN MICROWAVE UNIT. OR INTERCONNECT CABLE W1
RECONNECT W1 TO 7000A AND DISCONNECT FROM REAR PANEL OF MICROWAVE UNIT
+5V POWER SUPPLY OK ?
N
REPAIR OR REPLACE W1
IS THE DISPLAY OK ?
N
Y
PROBLEM IS IN THE MICROWAVE UNIT. REPAIR OR REPLACE
N
DISCONNECT P1 OF ANALOG PCB (A3) FROM J1 OF POWER SUPPLY PCB (A4)
+5V POWER SUPPLY OK ?
Y
PROBLEM IS IN ANALOG PCB (A3). REPAIR OR REPLACE
N
DISCONNECT F.P. CABLES FROM J1 AND J2 OF DIGITAL PCB (A2)
+5V POWER SUPPLY O.K. ?
Y
PROBLEM IS IN FRONT PANEL PCB (A1) REPAIR OR REPLACE
N
DISCONNECT P4 OF DIGITAL PCB (A2) FROM J4 OF POWER SUPPLY PCB. CONNECT A5Ω, 10W RESISTOR FROM +5V TO GROUND.
+5V POWER SUPPLY OK ?
Y
PROBLEM IS IN DIGITAL PCB. REPAIR OR REPLACE
N
PROBLEM IS IN POWER SUPPLY. REPAIR OR REPLACE
A
N
ONE OR MORE SEGMENTS ON LCD REMAIN BLANK ?
Y
7000A GOES TO VOLTMETER OPERATION AFTER APPROX. 10 SEC. ?
N
REMOVE W1 FROM REAR PANEL OF 7000A
1
Y
PROBLEM IS IN FRONT PANEL PCB (A1). REPAIR OR REPLACE
N
ALL SEGMENTS OF LCD REMAIN ON ?
Y
Y
N
"E1" IS DISPLAYED ON LCD ?
Y
JUMPER A2TP2 ($\overline{\text{NMI}}$) TO A2TP3 (+5V). TURN UNIT OFF AND THEN ON AGAIN
"E1" DISPLAYED AGAIN ?
Y
PROBLEM IS IN RAM OR RAM DECODING SECTIONS OF DIGITAL PCB. REPAIR OR REPLACE
N
PROBLEM IS IN PIA, 220 HZ CLOCK OR $\overline{\text{NMI}}$ GENERATOR SECTIONS OF DIGITAL PCB.
B
"E2" IS DISPLAYED ON LCD ?
Y
JUMPER A2TP2 ($\overline{\text{NMI}}$) TO A2TP3 (+5V). TURN 7000A OFF AND THEN ON AGAIN
"E2" DISPLAYED AGAIN ?
Y
PROBLEM IS IN EPROM OR EPROM DECODING SECTIONS OF DIGITAL PCB. REPAIR OR REPLACE
C
S

Figure 4-16-1. Troubleshooting Chart for Self-Check Turn-On Procedure (Sheet 1 of 2)

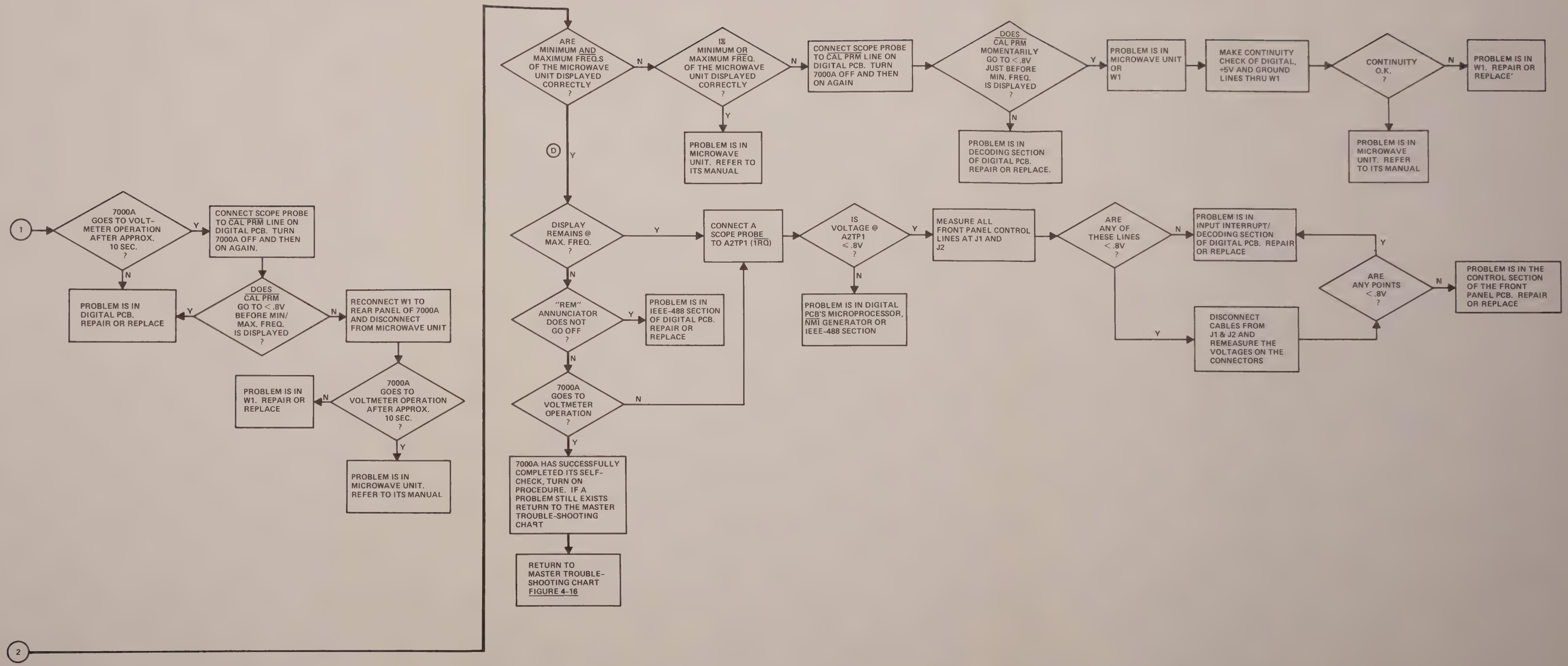
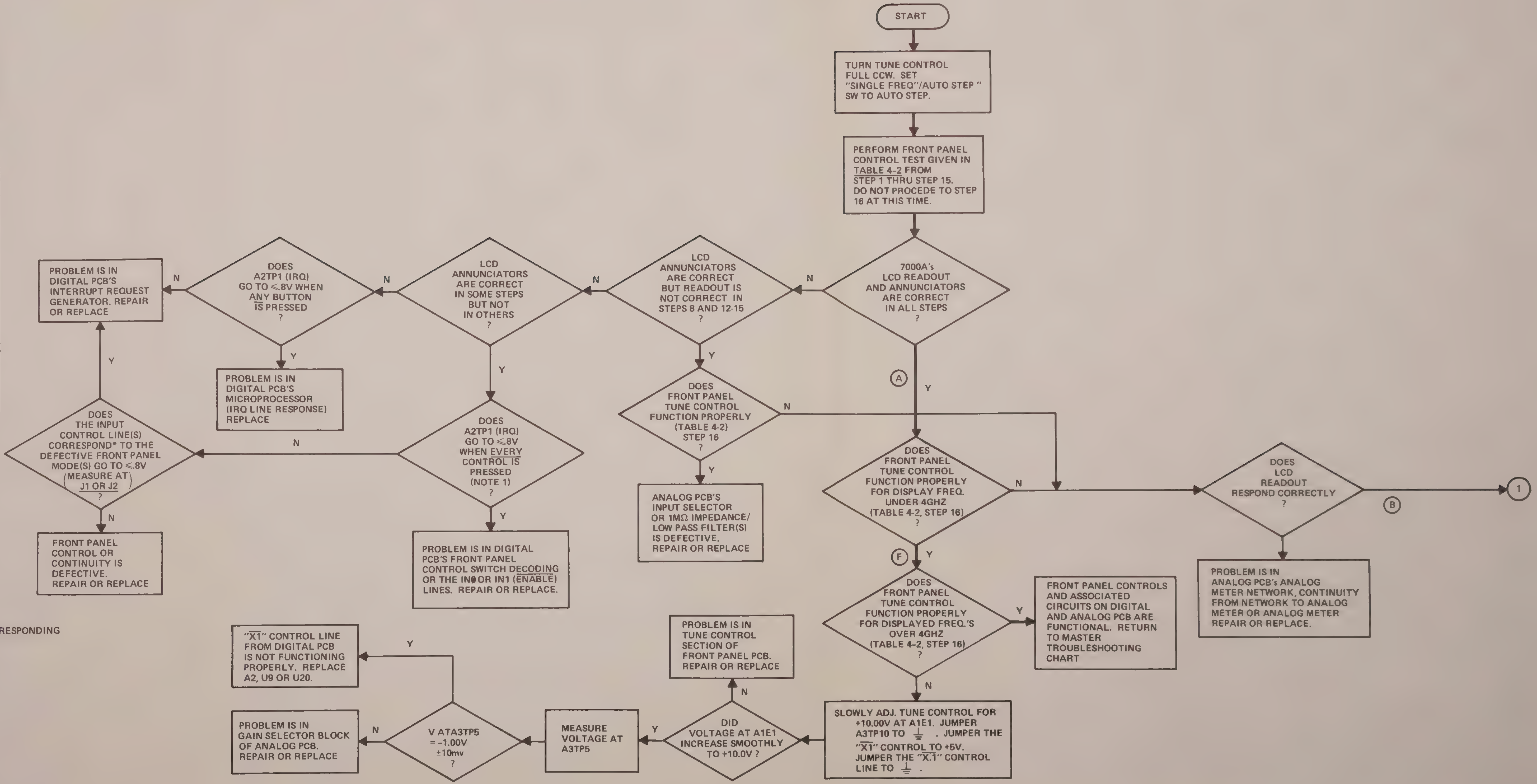

1
7000A GOES TO VOLT-METER OPERATION AFTER APPROX. 10 SEC. ?
Y
N
CONNECT SCOPE PROBE TO CAL PRM LINE ON DIGITAL PCB. TURN 7000A OFF AND THEN ON AGAIN.
PROBLEM IS IN DIGITAL PCB. REPAIR OR REPLACE
DOES CAL PRM GO TO < .8V BEFORE MIN/ MAX. FREQ. IS DISPLAYED ?
RECONNECT W1 TO REAR PANEL OF 7000A AND DISCONNECT FROM MICROWAVE UNIT
PROBLEM IS IN W1. REPAIR OR REPLACE
7000A GOES TO VOLTMETER OPERATION AFTER APPROX. 10 SEC. ?
PROBLEM IS IN MICROWAVE UNIT. REFER TO ITS MANUAL
2
ARE MINIMUM AND MAXIMUM FREQ.S OF THE MICROWAVE UNIT DISPLAYED CORRECTLY ?
IS MINIMUM OR MAXIMUM FREQ. OF THE MICROWAVE UNIT DISPLAYED CORRECTLY ?
PROBLEM IS IN MICROWAVE UNIT. REFER TO ITS MANUAL
CONNECT SCOPE PROBE TO CAL PRM LINE ON DIGITAL PCB. TURN 7000A OFF AND THEN ON AGAIN
DOES CAL PRM MOMENTARILY GO TO < .8V JUST BEFORE MIN. FREQ. IS DISPLAYED ?
PROBLEM IS IN DECODING SECTION OF DIGITAL PCB. REPAIR OR REPLACE.
PROBLEM IS IN MICROWAVE UNIT OR W1
MAKE CONTINUITY CHECK OF DIGITAL, +5V AND GROUND LINES THRU W1
CONTINUITY O.K. ?
PROBLEM IS IN W1. REPAIR OR REPLACE'
PROBLEM IS IN MICROWAVE UNIT. REFER TO ITS MANUAL
D
DISPLAY REMAINS @ MAX. FREQ. ?
CONNECT A SCOPE PROBE TO A2TP1 (IRQ)
IS VOLTAGE @ A2TP1 < .8V ?
PROBLEM IS IN DIGITAL PCB'S MICROPROCESSOR, NMI GENERATOR OR IEEE-488 SECTION
MEASURE ALL FRONT PANEL CONTROL LINES AT J1 AND J2
ARE ANY OF THESE LINES < .8V ?
PROBLEM IS IN INPUT INTERRUPT/ DECODING SECTION OF DIGITAL PCB. REPAIR OR REPLACE
ARE ANY POINTS < .8V ?
PROBLEM IS IN THE CONTROL SECTION OF THE FRONT PANEL PCB. REPAIR OR REPLACE
DISCONNECT CABLES FROM J1 & J2 AND REMEASURE THE VOLTAGES ON THE CONNECTORS
"REM" ANNUNCIATOR DOES NOT GO OFF ?
PROBLEM IS IN IEEE-488 SECTION OF DIGITAL PCB. REPAIR OR REPLACE
7000A GOES TO VOLTMETER OPERATION ?
7000A HAS SUCCESSFULLY COMPLETED ITS SELF-CHECK, TURN ON PROCEDURE. IF A PROBLEM STILL EXISTS RETURN TO THE MASTER TROUBLE-SHOOTING CHART
RETURN TO MASTER TROUBLE-SHOOTING CHART FIGURE 4-16

Figure 4-16-1. Troubleshooting Chart for Sel-Check Turn-On Procedure (Sheet 2 of 2)

FUNCTIONAL BLOCKS KNOWN GOOD FROM PRIOR TESTS	KEY	FUNCTIONAL BLOCKS JUST CHECKED - O.K.
DIGITAL PCB 1. MICROPROCESSOR (EXCEPT FOR $\overline{IRQ}$ & $\overline{NMI}$ INPUTS) 2. RAM AND RAM DECODING 3. EPROMS & EPROM DECODING 4. PART OF PIA-DECODER, CONTROL LINES, DATA LINES (D0-D7), PA0 & PB6 LINES 5. BUSSES: DATA, ADDRESS CONTROL BUSS 6. 4 MHZ CLOCK 7. IEEE-488 DECODING POWER SUPPLIES 1. +5V POWER SUPPLY (AND DISTRIBUTION) FRONT PANEL PCB 1. FRONT PANEL DISPLAY SECTION ANALOG PCB NONE MICROWAVE UNIT 1. CAL PRM DECODING 2. DIGITAL LINES (INCLUDING INTERCONNECT CABLE (W1)	Ⓐ	FRONT PANEL OPERATIONAL MODE CONTROL SWITCHES DIGITAL PCB: A) INTERRUPT REQUEST GEN B) FRONT PANEL CONTROL SWITCH DECODING C) $\overline{IRQ}$ INPUT TO MICROPROCESSOR
	Ⓑ	+ AND -15V POWER SUPPLIES AND DISTRIBUTION
	Ⓒ	ANALOG GROUND GENERATOR AND DISTRIBUTION
	Ⓓ	REFERENCE VOLTAGE GENERATOR AND DISTRIBUTION
	Ⓔ	A) D/A CONVERTER FOR ANALOG TO DIGITAL CONVERSION B) PIA BUS C) PIA-EXCEPT PB BUS
	Ⓕ	ANALOG BOARD BLOCKS: A) LOW PASS FILTER B) SAMPLE & HOLD (VOLTMETER OPERATION) C) SAMPLE & HOLD CONTROL (VOLTMETER OPERATION) D) COMPARATOR-FUNCTIONAL, NOT ACCURACY E) VOLTAGE DIVIDER - FUNCTIONAL NOT ACCURACY F) TTL LEVEL SHIFTER DIGITAL PCB BLOCKS A) COMP OUT LINE

NOTES 1. WHEN SINGLE FREQUENCY IS SELECTED A2TP1 SHOULD ONLY GO LOW MOMENTARILY. WHEN ANY PUSHBUTTON CONTROL IS PRESSED A1TP1 SHOULD REMAIN LOW UNTIL THE CONTROL IS RELEASED.


START
TURN TUNE CONTROL FULL CCW. SET "SINGLE FREQ"/AUTO STEP " SW TO AUTO STEP.
PERFORM FRONT PANEL CONTROL TEST GIVEN IN TABLE 4-2 FROM STEP 1 THRU STEP 15. DO NOT PROCEDE TO STEP 16 AT THIS TIME.
7000A's LCD READOUT AND ANNUNCIATORS ARE CORRECT IN ALL STEPS ?
N
Y
Ⓐ
LCD ANNUNCIATORS ARE CORRECT BUT READOUT IS NOT CORRECT IN STEPS 8 AND 12-15 ?
N
Y
LCD ANNUNCIATORS ARE CORRECT IN SOME STEPS BUT NOT IN OTHERS ?
N
Y
DOES A2TP1 (IRQ) GO TO ≤.8V WHEN ANY BUTTON IS PRESSED ?
N
Y
PROBLEM IS IN DIGITAL PCB'S INTERRUPT REQUEST GENERATOR. REPAIR OR REPLACE
PROBLEM IS IN DIGITAL PCB'S MICROPROCESSOR (IRQ LINE RESPONSE) REPLACE
DOES A2TP1 (IRQ) GO TO ≤.8V WHEN EVERY CONTROL IS PRESSED (NOTE 1) ?
N
Y
PROBLEM IS IN DIGITAL PCB'S FRONT PANEL CONTROL SWITCH DECODING OR THE IN0 OR IN1 (ENABLE) LINES. REPAIR OR REPLACE.
DOES THE INPUT CONTROL LINE(S) CORRESPOND* TO THE DEFECTIVE FRONT PANEL MODE(S) GO TO ≤.8V (MEASURE AT J1 OR J2) ?
Y
N
FRONT PANEL CONTROL OR CONTINUITY IS DEFECTIVE. REPAIR OR REPLACE
DOES FRONT PANEL TUNE CONTROL FUNCTION PROPERLY (TABLE 4-2) STEP 16 ?
N
Y
ANALOG PCB'S INPUT SELECTOR OR 1MΩ IMPEDANCE/ LOW PASS FILTER(S) IS DEFECTIVE. REPAIR OR REPLACE
DOES FRONT PANEL TUNE CONTROL FUNCTION PROPERLY FOR DISPLAY FREQ. UNDER 4GHZ (TABLE 4-2, STEP 16) ?
N
Y
Ⓕ
DOES LCD READOUT RESPOND CORRECTLY ?
Ⓑ
①
PROBLEM IS IN ANALOG PCB's ANALOG METER NETWORK, CONTINUITY FROM NETWORK TO ANALOG METER OR ANALOG METER REPAIR OR REPLACE.
DOES FRONT PANEL TUNE CONTROL FUNCTION PROPERLY FOR DISPLAYED FREQ.'S OVER 4GHZ (TABLE 4-2, STEP 16) ?
Y
N
FRONT PANEL CONTROLS AND ASSOCIATED CIRCUITS ON DIGITAL AND ANALOG PCB ARE FUNCTIONAL. RETURN TO MASTER TROUBLESHOOTING CHART
SLOWLY ADJ. TUNE CONTROL FOR +10.00V AT A1E1. JUMPER A3TP10 TO ⏚ . JUMPER THE "X1" CONTROL TO +5V. JUMPER THE "X.1" CONTROL LINE TO ⏚ .
DID VOLTAGE AT A1E1 INCREASE SMOOTHLY TO +10.0V ?
N
Y
PROBLEM IS IN TUNE CONTROL SECTION OF FRONT PANEL PCB. REPAIR OR REPLACE
MEASURE VOLTAGE AT A3TP5
V ATA3TP5 = -1.00V ±10mv ?
Y
N
"X1" CONTROL LINE FROM DIGITAL PCB IS NOT FUNCTIONING PROPERLY. REPLACE A2, U9 OR U20.
PROBLEM IS IN GAIN SELECTOR BLOCK OF ANALOG PCB. REPAIR OR REPLACE

*CORRESPONDING

Figure 4-16-2. Troubleshooting Chart for Front Panel Controls and Analog Meter (Sheet 1 of 3)

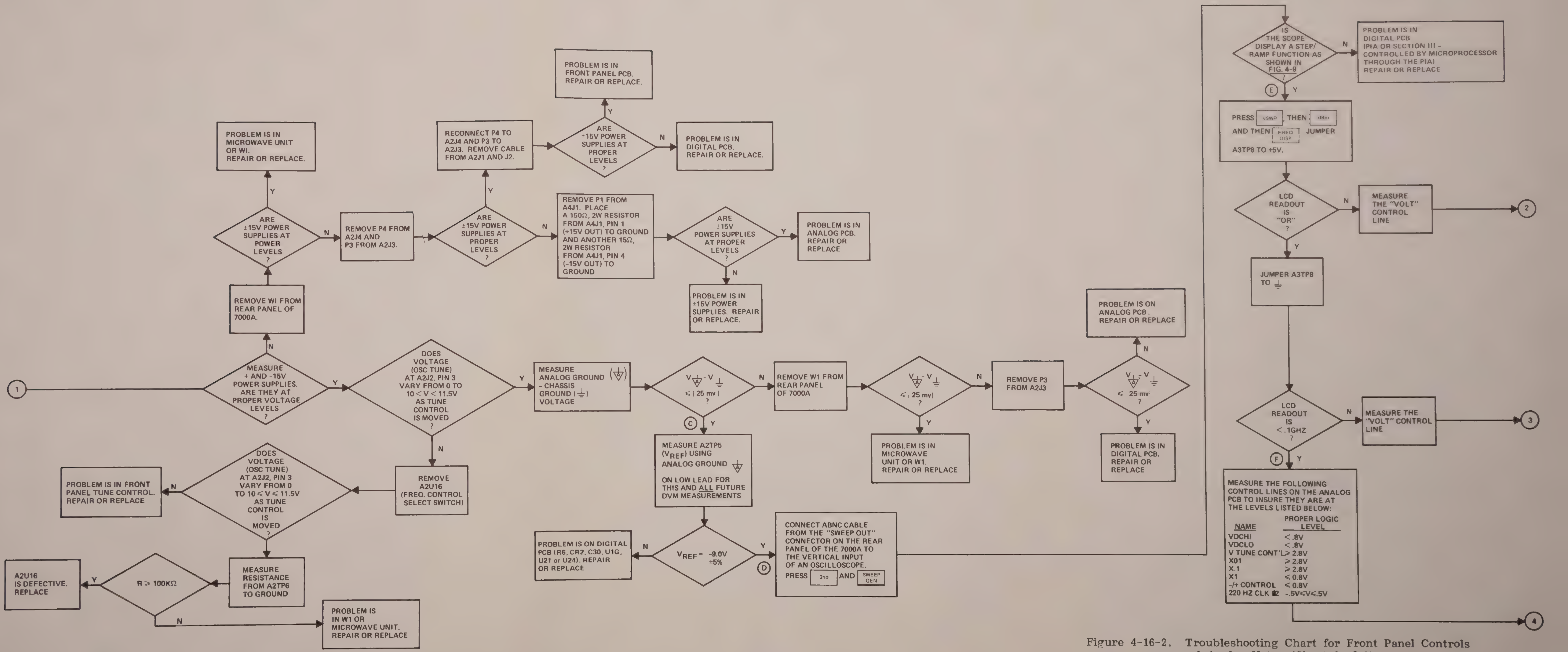

1
MEASURE + AND -15V POWER SUPPLIES. ARE THEY AT PROPER VOLTAGE LEVELS ?
Y
N
REMOVE WI FROM REAR PANEL OF 7000A.
ARE ±15V POWER SUPPLIES AT POWER LEVELS ?
Y
PROBLEM IS IN MICROWAVE UNIT OR WI. REPAIR OR REPLACE.
N
REMOVE P4 FROM A2J4 AND P3 FROM A2J3.
ARE ±15V POWER SUPPLIES AT PROPER LEVELS ?
Y
RECONNECT P4 TO A2J4 AND P3 TO A2J3. REMOVE CABLE FROM A2J1 AND J2.
ARE ±15V POWER SUPPLIES AT PROPER LEVELS ?
Y
PROBLEM IS IN FRONT PANEL PCB. REPAIR OR REPLACE.
N
PROBLEM IS IN DIGITAL PCB. REPAIR OR REPLACE.
N
REMOVE P1 FROM A4J1. PLACE A 150Ω, 2W RESISTOR FROM A4J1, PIN 1 (+15V OUT) TO GROUND AND ANOTHER 15Ω, 2W RESISTOR FROM A4J1, PIN 4 (-15V OUT) TO GROUND
ARE ±15V POWER SUPPLIES AT PROPER LEVELS ?
Y
PROBLEM IS IN ANALOG PCB. REPAIR OR REPLACE
N
PROBLEM IS IN ±15V POWER SUPPLIES. REPAIR OR REPLACE.
DOES VOLTAGE (OSC TUNE) AT A2J2, PIN 3 VARY FROM 0 TO 10 < V < 11.5V AS TUNE CONTROL IS MOVED ?
N
REMOVE A2U16 (FREQ. CONTROL SELECT SWITCH)
DOES VOLTAGE (OSC TUNE) AT A2J2, PIN 3 VARY FROM 0 TO 10 ≤ V < 11.5V AS TUNE CONTROL IS MOVED ?
N
PROBLEM IS IN FRONT PANEL TUNE CONTROL. REPAIR OR REPLACE
MEASURE RESISTANCE FROM A2TP6 TO GROUND
R > 100KΩ
Y
A2U16 IS DEFECTIVE. REPLACE
N
PROBLEM IS IN W1 OR MICROWAVE UNIT. REPAIR OR REPLACE
Y
MEASURE ANALOG GROUND (⏚) - CHASSIS GROUND (⏚) VOLTAGE
V⏚ - V⏚ ≤ | 25 mv | ?
C
Y
MEASURE A2TP5 (VREF) USING ANALOG GROUND ⏚ ON LOW LEAD FOR THIS AND ALL FUTURE DVM MEASUREMENTS
VREF = -9.0V ±5%
N
PROBLEM IS ON DIGITAL PCB (R6, CR2, C30, U1G, U21 or U24). REPAIR OR REPLACE
Y
D
CONNECT ABNC CABLE FROM THE "SWEEP OUT" CONNECTOR ON THE REAR PANEL OF THE 7000A TO THE VERTICAL INPUT OF AN OSCILLOSCOPE. PRESS 2nd AND SWEEP GEN
N
REMOVE W1 FROM REAR PANEL OF 7000A
V⏚ - V⏚ ≤ | 25 mv| ?
Y
PROBLEM IS IN MICROWAVE UNIT OR W1. REPAIR OR REPLACE
N
REMOVE P3 FROM A2J3
V⏚ - V⏚ ≤ | 25 mv| ?
N
PROBLEM IS ON ANALOG PCB . REPAIR OR REPLACE
Y
PROBLEM IS IN DIGITAL PCB. REPAIR OR REPLACE
IS THE SCOPE DISPLAY A STEP/ RAMP FUNCTION AS SHOWN IN FIG. 4-9 ?
N
PROBLEM IS IN DIGITAL PCB (PIA OR SECTION III - CONTROLLED BY MICROPROCESSOR THROUGH THE PIA) REPAIR OR REPLACE
E
Y
PRESS VSWR, THEN dBm AND THEN FREQ DISP JUMPER A3TP8 TO +5V.
LCD READOUT IS "OR" ?
N
MEASURE THE "VOLT" CONTROL LINE
2
Y
JUMPER A3TP8 TO ⏚
LCD READOUT IS < .1GHZ ?
N
MEASURE THE "VOLT" CONTROL LINE
3
F
Y
MEASURE THE FOLLOWING CONTROL LINES ON THE ANALOG PCB TO INSURE THEY ARE AT THE LEVELS LISTED BELOW:
NAME — PROPER LOGIC LEVEL
VDCHI < .8V
VDCLO < .8V
V TUNE CONT'L > 2.8V
X01 ≥ 2.8V
X.1 ≥ 2.8V
X1 ≤ 0.8V
-/+ CONTROL ≤ 0.8V
220 HZ CLK ⌀2 -.5V≤V≤.5V
4

Figure 4-16-2. Troubleshooting Chart for Front Panel Controls and Analog Meter (Sheet 2 of 3)

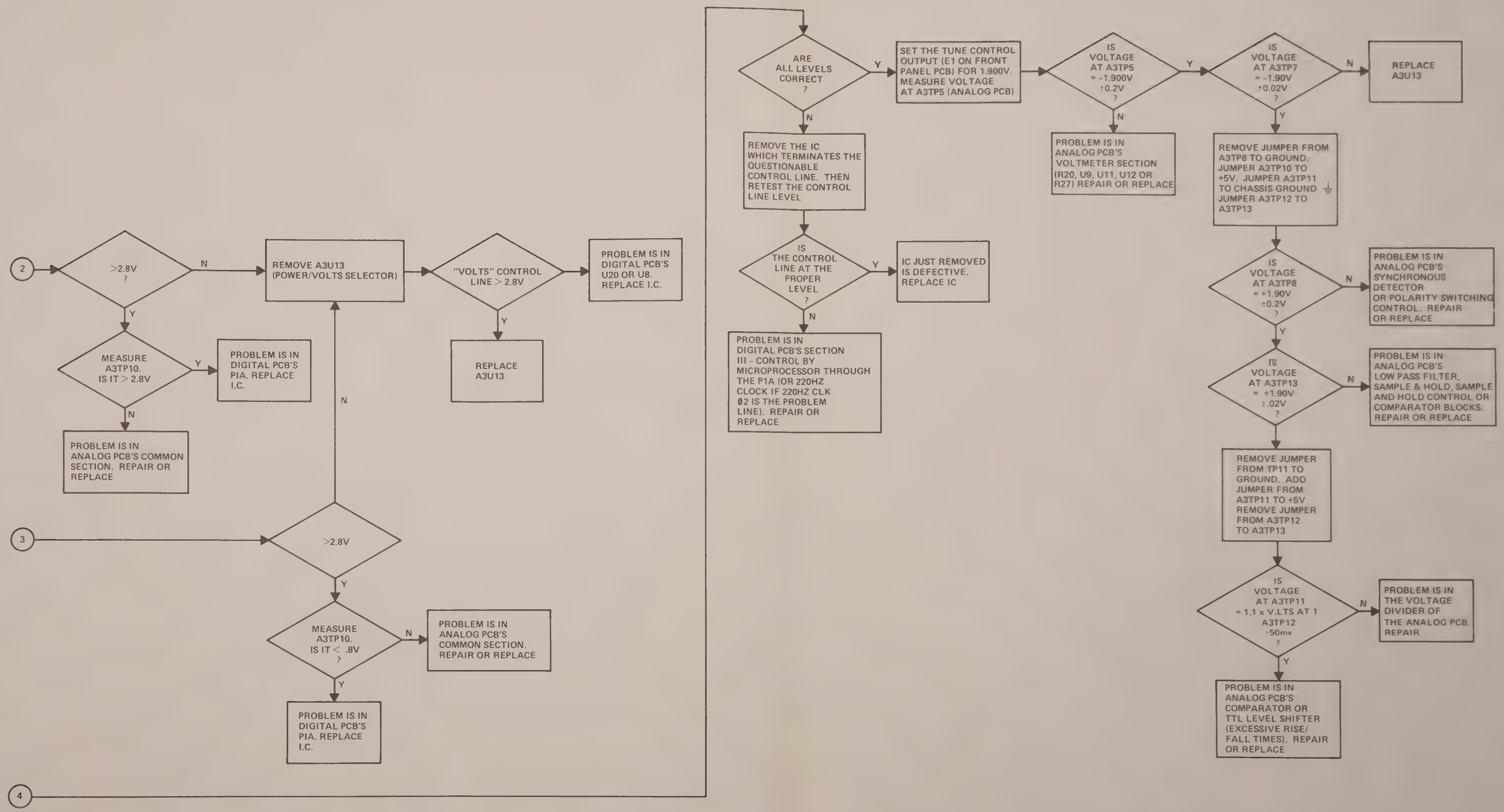

2
>2.8V ?
N
Y
REMOVE A3U13 (POWER/VOLTS SELECTOR)
"VOLTS" CONTROL LINE > 2.8V
PROBLEM IS IN DIGITAL PCB'S U20 OR U8. REPLACE I.C.
Y
REPLACE A3U13
MEASURE A3TP10. IS IT > 2.8V
Y
PROBLEM IS IN DIGITAL PCB'S PIA. REPLACE I.C.
N
PROBLEM IS IN ANALOG PCB'S COMMON SECTION. REPAIR OR REPLACE
N
3
>2.8V
Y
MEASURE A3TP10. IS IT < .8V ?
N
PROBLEM IS IN ANALOG PCB'S COMMON SECTION. REPAIR OR REPLACE
Y
PROBLEM IS IN DIGITAL PCB'S PIA. REPLACE I.C.
4
ARE ALL LEVELS CORRECT ?
Y
SET THE TUNE CONTROL OUTPUT (E1 ON FRONT PANEL PCB) FOR 1.900V. MEASURE VOLTAGE AT A3TP5 (ANALOG PCB)
IS VOLTAGE AT A3TP5 = -1.900V ±0.2V ?
Y
IS VOLTAGE AT A3TP7 = -1.90V ±0.02V ?
N
REPLACE A3U13
N
REMOVE THE IC WHICH TERMINATES THE QUESTIONABLE CONTROL LINE. THEN RETEST THE CONTROL LINE LEVEL
N
PROBLEM IS IN ANALOG PCB'S VOLTMETER SECTION (R20, U9, U11, U12 OR R27) REPAIR OR REPLACE
Y
REMOVE JUMPER FROM A3TP8 TO GROUND. JUMPER A3TP10 TO +5V. JUMPER A3TP11 TO CHASSIS GROUND ⏚ JUMPER A3TP12 TO A3TP13
IS THE CONTROL LINE AT THE PROPER LEVEL ?
Y
IC JUST REMOVED IS DEFECTIVE. REPLACE IC
N
PROBLEM IS IN DIGITAL PCB'S SECTION III - CONTROL BY MICROPROCESSOR THROUGH THE P1A (OR 220HZ CLOCK IF 220HZ CLK Ø2 IS THE PROBLEM LINE). REPAIR OR REPLACE
IS VOLTAGE AT A3TP8 = +1.90V ±0.2V ?
N
PROBLEM IS IN ANALOG PCB'S SYNCHRONOUS DETECTOR OR POLARITY SWITCHING CONTROL. REPAIR OR REPLACE
Y
IS VOLTAGE AT A3TP13 = +1.90V ±.02V ?
N
PROBLEM IS IN ANALOG PCB'S LOW PASS FILTER, SAMPLE & HOLD, SAMPLE AND HOLD CONTROL OR COMPARATOR BLOCKS. REPAIR OR REPLACE
REMOVE JUMPER FROM TP11 TO GROUND. ADD JUMPER FROM A3TP11 TO +5V REMOVE JUMPER FROM A3TP12 TO A3TP13
IS VOLTAGE AT A3TP11 = 1.1 x V.LTS AT 1 A3TP12 ±50mv ?
N
PROBLEM IS IN THE VOLTAGE DIVIDER OF THE ANALOG PCB. REPAIR
Y
PROBLEM IS IN ANALOG PCB'S COMPARATOR OR TTL LEVEL SHIFTER (EXCESSIVE RISE/ FALL TIMES). REPAIR OR REPLACE

Figure 4-16-2. Troubleshooting Chart for Front Panel Controls and Analog Meter (Sheet 3 of 3)

FUNCTIONAL BLOCKS KNOWN GOOD FROM PRIOR TESTS	KEY	FUNCTIONAL BLOCKS JUST CHECKED - O.K.
POWER SUPPLIES 1. +5V 2. +15V 3. -15V FRONT PANEL ENTIRE PCB + ANALOG METER DIGITAL PCB 1. MICROPROCESSOR - EXCEPT NMI INPUT 2. RAM AND RAM DECODING 3. EPROMS & EPROM DECODING 4. PIA - EXCEPT PB1, 4 & 5 OUTPUTS 5. BUSSES: ALL (DATA, ADDRESS, CONTROL, PA & PB) EXCEPT PB1, 4 & 5 LINES 6. 4 MHZ CLOCK 7. IEEE 488 DECODING 8. REFERENCE VOLTAGE GENERATOR 9. D/A CONVERTER FOR A/D CONVERSION (U18 & 19) - BASIC OPERATION BUT NOT ACCURACY 10. P/O LATCHING BUFFER FOR ANALOG BOARD CONTROLS 11. INTERRUPT REQUEST GENERATOR 12. FRONT PANEL CONTROL SWITCH DECODING ANALOG PCB 1. ANALOG GROUND GENERATOR 2. VOLTMETER SECTION A. 1MΩ IMPEDANCE (R20) B' INPUT SELECTOR - OSC TUNE POSITION ONLY C. AMPLIFIER D. GAIN SELECTOR - FOR X1 AND X.1 POSITIONS 4. COMMON SECTION A. POWER/VOLTAGE SELECTOR - VOLTAGE POSITION ONLY B. POLARITY SWITCHING CONTROL - FOR + INPUT VOLTAGES ONLY (-/+ CONTROL LINE @ ≤.8V) C. LOW PASS FILTER D. ANALOG METER NETWORK E. SAMPLE AND HOLD - VOLTAGE MODE ONLY F. SAMPLE AND HOLD CONTROL - VOLTAGE MODE ONLY G. COMPARATOR H. VOLTAGE DIVIDER I. TTL LEVEL SHIFTER MICROWAVE UNIT 1. CAL PRM DECODING 2. DIGITAL LINES (INCLUDING INTERCONNECT CABLE (W1))	Ⓐ	ANALOG PCB VOLTMETER SECTION'S "1MΩ IMPEDANCE" FOR VDC HI PROBE
	Ⓑ	ANALOG PCB VOLTMETER SECTION'S "1MΩ IMPEDANCE" FOR VDC LO PROBE
	Ⓒ	ANALOG PCB COMMON SECTION'S POLARITY SWITCHING CONTROL & SYNCHRONOUS DETECTOR FOR VOLTMETER OPERATION
	Ⓓ	ANALOG PCB: COMMON SECTION OFFSET NULLS OF OP AMPS.

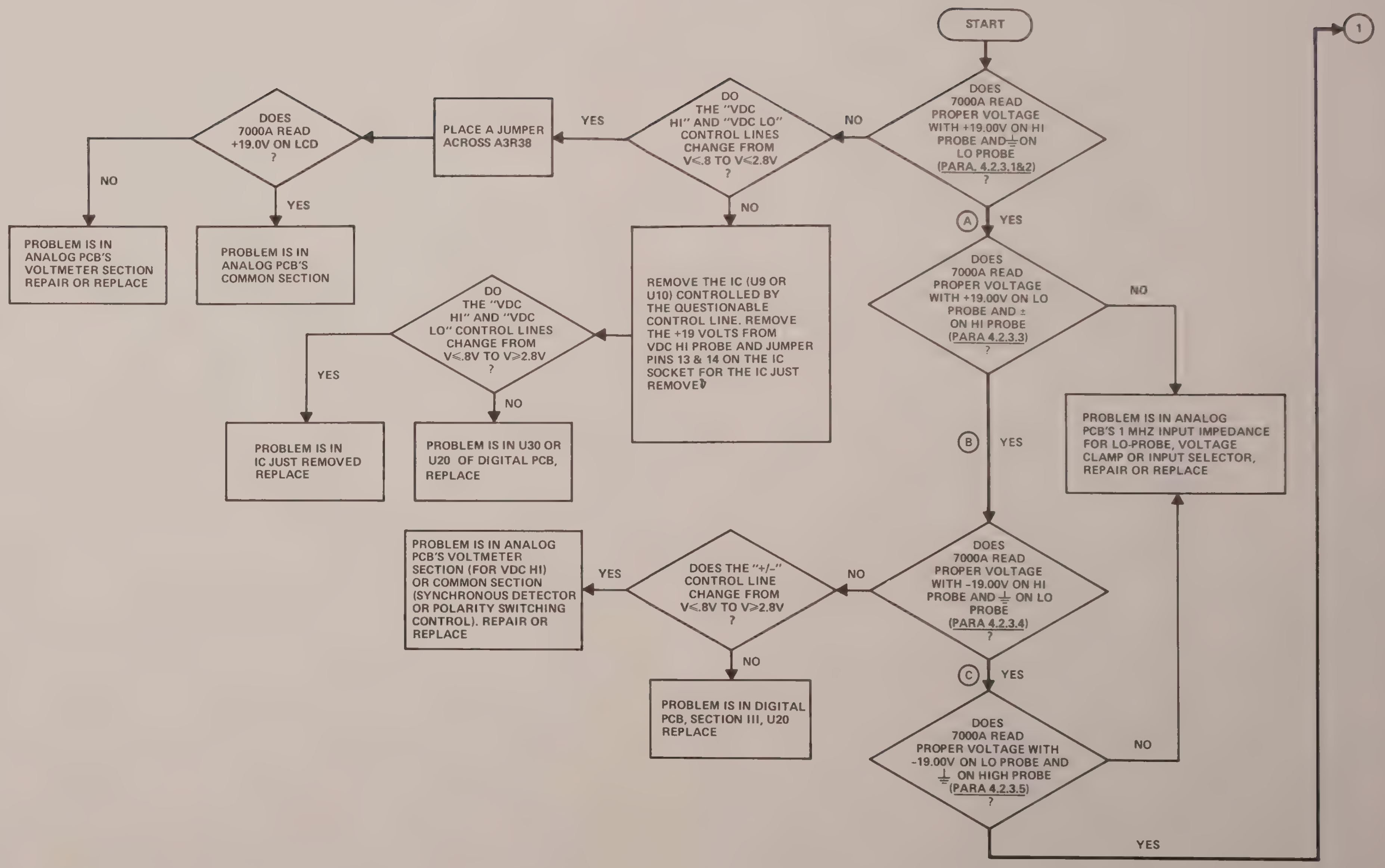

START
DOES 7000A READ PROPER VOLTAGE WITH +19.00V ON HI PROBE AND ⏚ ON LO PROBE (PARA. 4.2.3.1&2) ?
NO
DO THE "VDC HI" AND "VDC LO" CONTROL LINES CHANGE FROM V≤.8 TO V≤2.8V ?
YES
PLACE A JUMPER ACROSS A3R38
DOES 7000A READ +19.0V ON LCD ?
NO
PROBLEM IS IN ANALOG PCB'S VOLTMETER SECTION REPAIR OR REPLACE
YES
PROBLEM IS IN ANALOG PCB'S COMMON SECTION
NO
REMOVE THE IC (U9 OR U10) CONTROLLED BY THE QUESTIONABLE CONTROL LINE. REMOVE THE +19 VOLTS FROM VDC HI PROBE AND JUMPER PINS 13 & 14 ON THE IC SOCKET FOR THE IC JUST REMOVED
DO THE "VDC HI" AND "VDC LO" CONTROL LINES CHANGE FROM V≤.8V TO V≥2.8V ?
YES
PROBLEM IS IN IC JUST REMOVED REPLACE
NO
PROBLEM IS IN U30 OR U20 OF DIGITAL PCB, REPLACE
Ⓐ YES
DOES 7000A READ PROPER VOLTAGE WITH +19.00V ON LO PROBE AND ± ON HI PROBE (PARA 4.2.3.3) ?
NO
PROBLEM IS IN ANALOG PCB'S 1 MHZ INPUT IMPEDANCE FOR LO-PROBE, VOLTAGE CLAMP OR INPUT SELECTOR, REPAIR OR REPLACE
Ⓑ YES
DOES 7000A READ PROPER VOLTAGE WITH -19.00V ON HI PROBE AND ⏚ ON LO PROBE (PARA 4.2.3.4) ?
NO
DOES THE "+/-" CONTROL LINE CHANGE FROM V≤.8V TO V≥2.8V ?
YES
PROBLEM IS IN ANALOG PCB'S VOLTMETER SECTION (FOR VDC HI) OR COMMON SECTION (SYNCHRONOUS DETECTOR OR POLARITY SWITCHING CONTROL). REPAIR OR REPLACE
NO
PROBLEM IS IN DIGITAL PCB, SECTION III, U20 REPLACE
Ⓒ YES
DOES 7000A READ PROPER VOLTAGE WITH -19.00V ON LO PROBE AND ⏚ ON HIGH PROBE (PARA 4.2.3.5) ?
NO
YES
①

Figure 4-16-3. Troubleshooting Chart for Voltmeter Operation (Sheet 1 of 2)

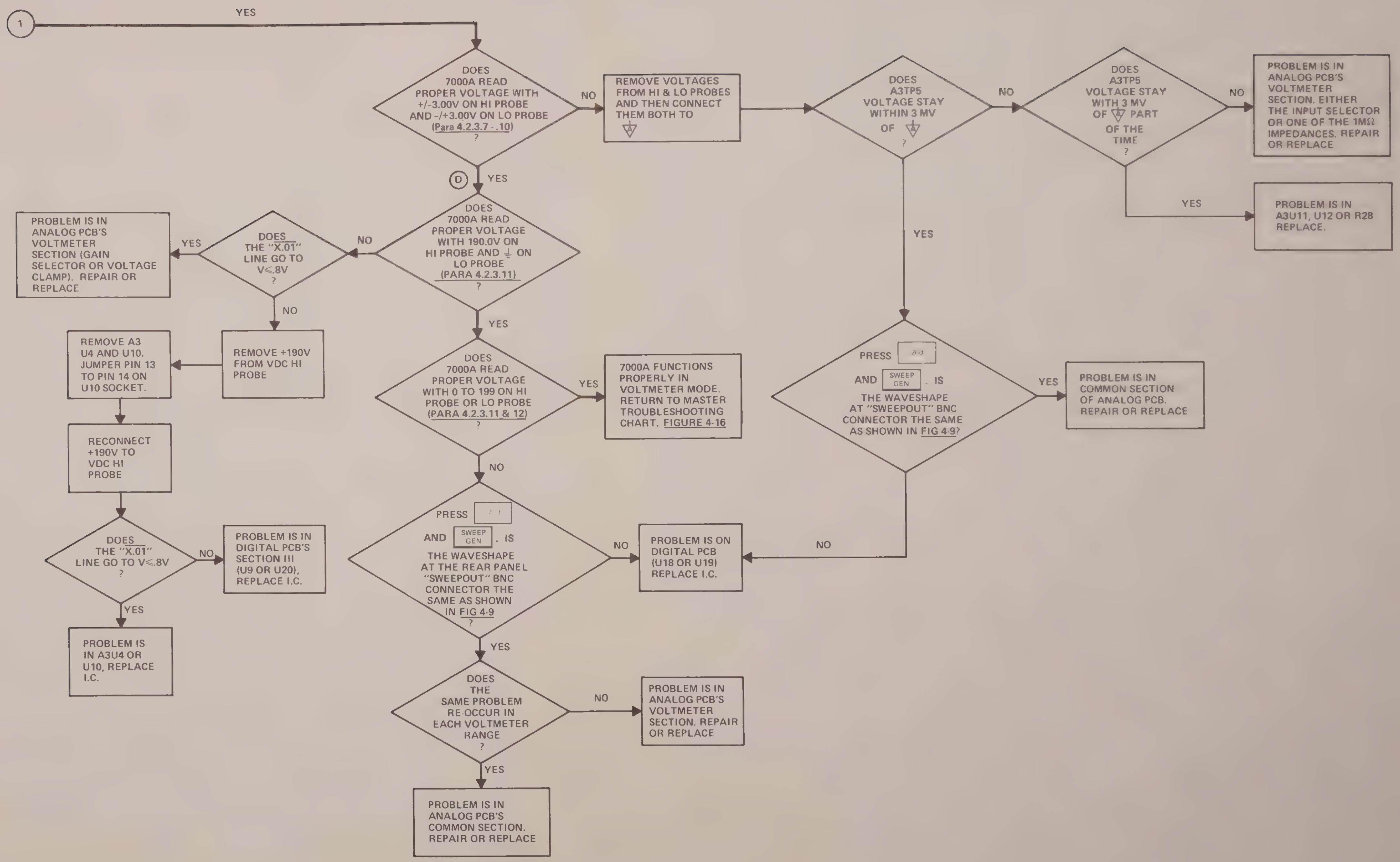

1
YES
DOES 7000A READ PROPER VOLTAGE WITH +/-3.00V ON HI PROBE AND -/+3.00V ON LO PROBE (Para 4.2.3.7 - .10) ?
NO
REMOVE VOLTAGES FROM HI & LO PROBES AND THEN CONNECT THEM BOTH TO ⏚
DOES A3TP5 VOLTAGE STAY WITHIN 3 MV OF ⏚ ?
NO
DOES A3TP5 VOLTAGE STAY WITH 3 MV OF ⏚ PART OF THE TIME ?
NO
PROBLEM IS IN ANALOG PCB'S VOLTMETER SECTION. EITHER THE INPUT SELECTOR OR ONE OF THE 1MΩ IMPEDANCES. REPAIR OR REPLACE
YES
PROBLEM IS IN A3U11, U12 OR R28 REPLACE.
YES
D
YES
DOES 7000A READ PROPER VOLTAGE WITH 190.0V ON HI PROBE AND ⏚ ON LO PROBE (PARA 4.2.3.11) ?
NO
DOES THE "X.01" LINE GO TO V≤.8V ?
YES
PROBLEM IS IN ANALOG PCB'S VOLTMETER SECTION (GAIN SELECTOR OR VOLTAGE CLAMP). REPAIR OR REPLACE
NO
REMOVE +190V FROM VDC HI PROBE
REMOVE A3 U4 AND U10. JUMPER PIN 13 TO PIN 14 ON U10 SOCKET.
RECONNECT +190V TO VDC HI PROBE
DOES THE "X.01" LINE GO TO V≤.8V ?
NO
PROBLEM IS IN DIGITAL PCB'S SECTION III (U9 OR U20), REPLACE I.C.
YES
PROBLEM IS IN A3U4 OR U10, REPLACE I.C.
YES
DOES 7000A READ PROPER VOLTAGE WITH 0 TO 199 ON HI PROBE OR LO PROBE (PARA 4.2.3.11 & 12) ?
YES
7000A FUNCTIONS PROPERLY IN VOLTMETER MODE. RETURN TO MASTER TROUBLESHOOTING CHART. FIGURE 4-16
NO
PRESS [ ] AND [SWEEP GEN]. IS THE WAVESHAPE AT THE REAR PANEL "SWEEPOUT" BNC CONNECTOR THE SAME AS SHOWN IN FIG 4-9 ?
NO
PROBLEM IS ON DIGITAL PCB (U18 OR U19) REPLACE I.C.
YES
PRESS [ ] AND [SWEEP GEN]. IS THE WAVESHAPE AT "SWEEPOUT" BNC CONNECTOR THE SAME AS SHOWN IN FIG 4-9?
YES
PROBLEM IS IN COMMON SECTION OF ANALOG PCB. REPAIR OR REPLACE
NO
YES
DOES THE SAME PROBLEM RE-OCCUR IN EACH VOLTMETER RANGE ?
NO
PROBLEM IS IN ANALOG PCB'S VOLTMETER SECTION. REPAIR OR REPLACE
YES
PROBLEM IS IN ANALOG PCB'S COMMON SECTION. REPAIR OR REPLACE

Figure 4-16-3. Troubleshooting Chart for Voltmeter Operation (Sheet 2 of 2)

FUNCTIONAL BLOCKS KNOWN GOOD FROM PRIOR TESTS	KEY	FUNCTIONAL BLOCKS JUST CHECKED O.K.
POWER SUPPLIES 1. +5V 2. +15V 3. -15V FRONT PANEL ENTIRE PCB & ANALOG METER DIGITAL PCB 1. SECTION I - INPUTS TO MICROPROCESSOR A. INTERRUPT-REQUEST GENERATOR B. FRONT PANEL CONTROL SWITCH DECODING C. 4 MHZ CLOCK 2. SECTION II - DIRECT CONTROL BY MICROPROCESSOR ENTIRE SECTION EXCEPT IEEE-488 OPTION AND $\overline{\text{NMI}}$ INPUT TO MICROPROCESSOR 3. SECTION III - CONTROL BY MICROPROCESSOR THROUGH THE PIA A. REFERENCE VOLTAGE GENERATOR B. D/A CONVERTER FOR A/D CONVERSION C. LATCHING BUFFER FOR ANALOG BOARD CONTROLS EXCEPT: $\overline{\text{RANGE CONT'L}}$ 1, 2, 6 & 7 OUTPUTS ANALOG PCB 1. ANALOG GROUND GENERATOR 2. VOLTMETER SECTION: ENTIRE SECTION 3. POWER METER AMPLIFIER: NONE 4. COMMON SECTION: ENTIRE SECTION - FOR VOLTMETER OPERATION ONLY MICROWAVE UNIT 1. CAL PRM DECODING 2. DIGITAL LINES (INCLUDING INTERCONNECT CABLE W1) TO CALIBRATION PROM	Ⓐ	1. DIGITAL PCB, SECTION 3 A. CONTROL LINES - "PWR" & "$\overline{\text{220}}$ HZ OFF" B. $\overline{\text{NMI}}$ GENERATOR C. 220 HZ CLOCK, Ø2 2. DIGITAL PCB, SECTION 1: $\overline{\text{NMI}}$ INPUT TO MICROPROCESSOR
	Ⓑ	220 HZ CLOCK Ø1
	Ⓒ	DIGITAL PCB, SECTION III, D/A CONVERTER FOR POWER SENSOR AUTO-ZERO
	Ⓓ	MICROWAVE UNIT A. 220 HZ CHOPPER DRIVE B. DETECTOR ZERO CONTROL C. 220 HZ AMPLIFIER D. 220 HZ PREAMP AND 220 HZ CHOPPER IN THE DETECTOR
	Ⓔ	DIGITAL PCB, SECTION III, LATCHING BUFFER FOR ANALOG BOARD CONTROLS

REPRINT OF TABLE 4-8

INPUT POWER LEVEL	RANGE	$\overline{\text{RANGE CONT'L}}$ - LINES TRUE	GAIN OF SELECTABLE ATTENUATORS		
(dbm)	-	V ⩽ 0.8V	#1	#2	#3
+13 → +4	1	1, 5, 6	÷ 256	÷ 256	÷ 4
+4 → -15	2	1, 5, 7	÷ 256	÷ 256	÷ 1
-15 → -21	3	1, 4, 6	÷ 256	÷ 4	÷ 4
-21 → -27	4	2, 5, 6	÷ 1	÷ 256	÷ 4
-27 → -38	5	2, 5, 7	÷ 1	÷ 256	÷ 1
-38 → -50	6	2, 4, 6	÷ 1	÷ 4	÷ 4
-50 → -∞	7	2, 3, 6	÷ 1	÷ 1	÷ 4

NOTE 1: THE MOST PROBABLE CAUSES OF A PROBLEM IN POWER METER MODE ARE IN THE MICROWAVE UNIT. HENCE, IT MAY SAVE TIME TO TEMPORARILY REPLACE THE MICROWAVE UNIT IF ANOTHER ONE IS READILY AVAILABLE TO SEE IF IT IS DEFECTIVE.

2: THE 7000A IS BEING SET TO ATTEMPT AN AUTO-ZERO IN POWER METER MODE. THE 1MW INPUT TO THE MICROWAVE DETECTOR SHOULD NOT ALLOW THE 7000A TO ZERO. HENCE THE 7000A WILL REMAIN IN ITS MOST SENSITIVE RANGE, CONTINUOUSLY CHANGING ITS' ZEROING VOLTAGE AND THEN TESTING FOR AN IN-RANGE ZERO MEASUREMENT.

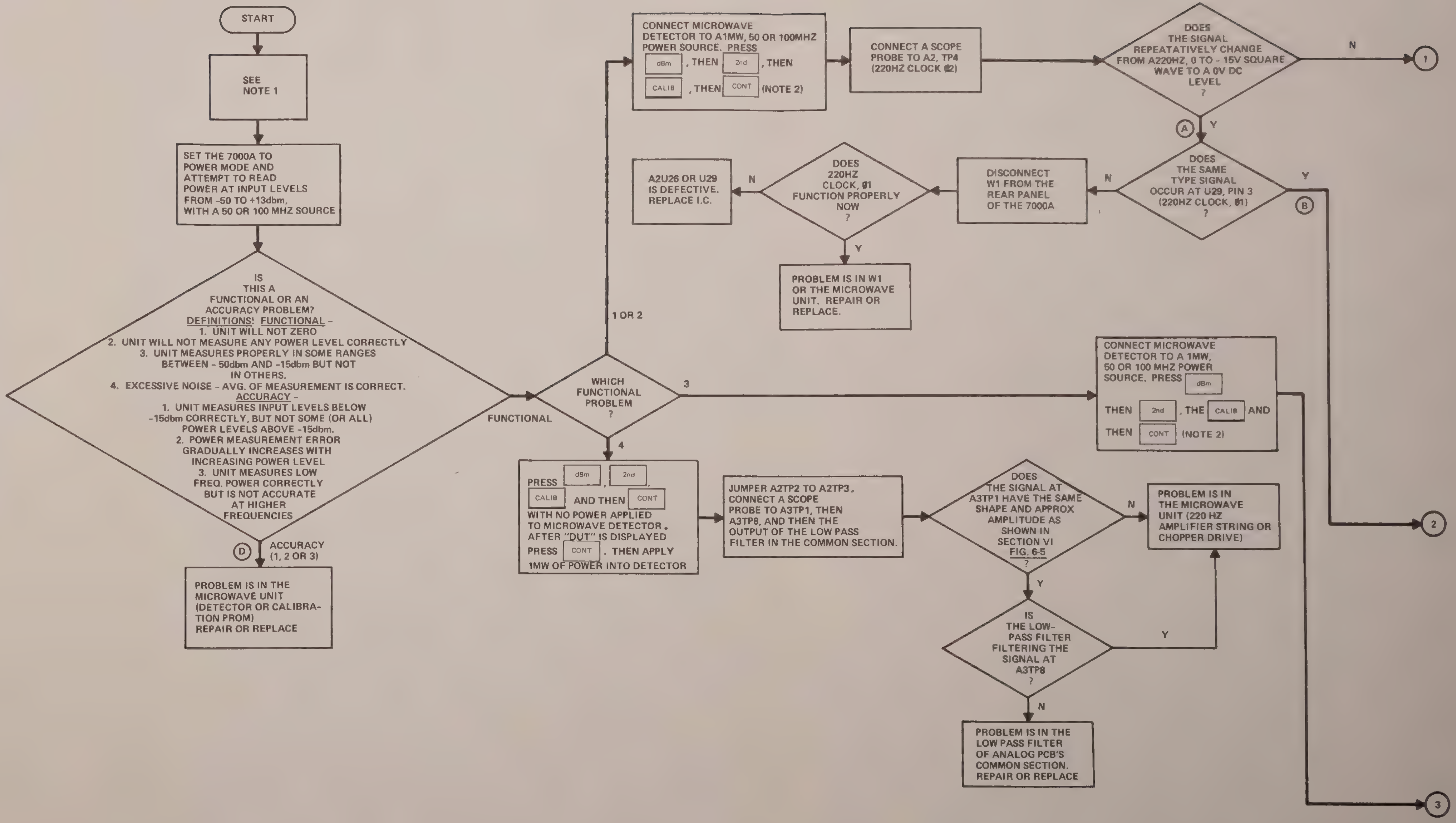

START
SEE NOTE 1
SET THE 7000A TO POWER MODE AND ATTEMPT TO READ POWER AT INPUT LEVELS FROM -50 TO +13dbm, WITH A 50 OR 100 MHZ SOURCE
IS THIS A FUNCTIONAL OR AN ACCURACY PROBLEM?
DEFINITIONS: FUNCTIONAL -
1. UNIT WILL NOT ZERO
2. UNIT WILL NOT MEASURE ANY POWER LEVEL CORRECTLY
3. UNIT MEASURES PROPERLY IN SOME RANGES BETWEEN - 50dbm AND -15dbm BUT NOT IN OTHERS.
4. EXCESSIVE NOISE - AVG. OF MEASUREMENT IS CORRECT.
ACCURACY -
1. UNIT MEASURES INPUT LEVELS BELOW -15dbm CORRECTLY, BUT NOT SOME (OR ALL) POWER LEVELS ABOVE -15dbm.
2. POWER MEASUREMENT ERROR GRADUALLY INCREASES WITH INCREASING POWER LEVEL
3. UNIT MEASURES LOW FREQ. POWER CORRECTLY BUT IS NOT ACCURATE AT HIGHER FREQUENCIES
Ⓓ
ACCURACY (1, 2 OR 3)
PROBLEM IS IN THE MICROWAVE UNIT (DETECTOR OR CALIBRATION PROM) REPAIR OR REPLACE
FUNCTIONAL
WHICH FUNCTIONAL PROBLEM ?
1 OR 2
3
4
CONNECT MICROWAVE DETECTOR TO A1MW, 50 OR 100MHZ POWER SOURCE. PRESS dBm , THEN 2nd , THEN CALIB , THEN CONT (NOTE 2)
CONNECT A SCOPE PROBE TO A2, TP4 (220HZ CLOCK Ø2)
DOES THE SIGNAL REPEATATIVELY CHANGE FROM A220HZ, 0 TO - 15V SQUARE WAVE TO A 0V DC LEVEL ?
N
①
Ⓐ
Y
DOES THE SAME TYPE SIGNAL OCCUR AT U29, PIN 3 (220HZ CLOCK, Ø1) ?
Y
Ⓑ
N
DISCONNECT W1 FROM THE REAR PANEL OF THE 7000A
DOES 220HZ CLOCK, Ø1 FUNCTION PROPERLY NOW ?
N
A2U26 OR U29 IS DEFECTIVE. REPLACE I.C.
Y
PROBLEM IS IN W1 OR THE MICROWAVE UNIT. REPAIR OR REPLACE.
②
CONNECT MICROWAVE DETECTOR TO A 1MW, 50 OR 100 MHZ POWER SOURCE. PRESS dBm THEN 2nd , THE CALIB AND THEN CONT (NOTE 2)
③
PRESS dBm , 2nd , CALIB AND THEN CONT WITH NO POWER APPLIED TO MICROWAVE DETECTOR. AFTER "DUT" IS DISPLAYED PRESS CONT . THEN APPLY 1MW OF POWER INTO DETECTOR
JUMPER A2TP2 TO A2TP3, CONNECT A SCOPE PROBE TO A3TP1, THEN A3TP8, AND THEN THE OUTPUT OF THE LOW PASS FILTER IN THE COMMON SECTION.
DOES THE SIGNAL AT A3TP1 HAVE THE SAME SHAPE AND APPROX AMPLITUDE AS SHOWN IN SECTION VI FIG. 6-5 ?
N
PROBLEM IS IN THE MICROWAVE UNIT (220 HZ AMPLIFIER STRING OR CHOPPER DRIVE)
Y
IS THE LOW-PASS FILTER FILTERING THE SIGNAL AT A3TP8 ?
Y
N
PROBLEM IS IN THE LOW PASS FILTER OF ANALOG PCB'S COMMON SECTION. REPAIR OR REPLACE

Figure 4-16-4. Troubleshooting Chart for Power Meter Operation (Sheet 1 of 3)

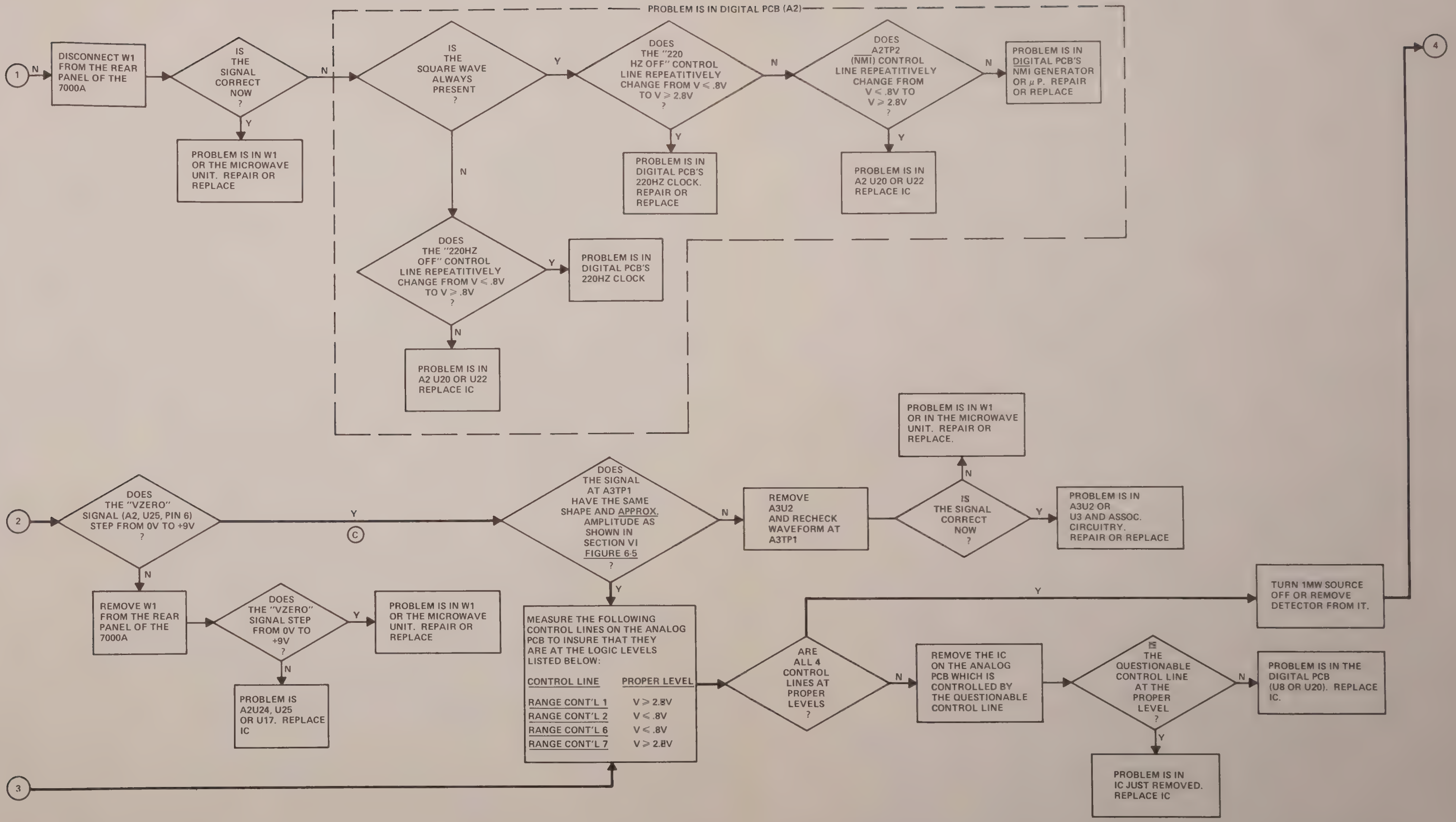

PROBLEM IS IN DIGITAL PCB (A2)
1
DISCONNECT W1 FROM THE REAR PANEL OF THE 7000A
IS THE SIGNAL CORRECT NOW ?
PROBLEM IS IN W1 OR THE MICROWAVE UNIT. REPAIR OR REPLACE
IS THE SQUARE WAVE ALWAYS PRESENT ?
DOES THE "220 HZ OFF" CONTROL LINE REPEATITIVELY CHANGE FROM V ≤ .8V TO V ≥ 2.8V ?
PROBLEM IS IN DIGITAL PCB'S 220HZ CLOCK. REPAIR OR REPLACE
DOES A2TP2 (NMI) CONTROL LINE REPEATITIVELY CHANGE FROM V ≤ .8V TO V ≥ 2.8V ?
PROBLEM IS IN DIGITAL PCB'S NMI GENERATOR OR μP. REPAIR OR REPLACE
PROBLEM IS IN A2 U20 OR U22 REPLACE IC
DOES THE "220HZ OFF" CONTROL LINE REPEATITIVELY CHANGE FROM V ≤ .8V TO V ≥ .8V ?
PROBLEM IS IN DIGITAL PCB'S 220HZ CLOCK
PROBLEM IS IN A2 U20 OR U22 REPLACE IC
2
DOES THE "VZERO" SIGNAL (A2, U25, PIN 6) STEP FROM 0V TO +9V ?
C
REMOVE W1 FROM THE REAR PANEL OF THE 7000A
DOES THE "VZERO" SIGNAL STEP FROM 0V TO +9V ?
PROBLEM IS IN W1 OR THE MICROWAVE UNIT. REPAIR OR REPLACE
PROBLEM IS A2U24, U25 OR U17. REPLACE IC
DOES THE SIGNAL AT A3TP1 HAVE THE SAME SHAPE AND APPROX. AMPLITUDE AS SHOWN IN SECTION VI FIGURE 6-5 ?
REMOVE A3U2 AND RECHECK WAVEFORM AT A3TP1
IS THE SIGNAL CORRECT NOW ?
PROBLEM IS IN W1 OR IN THE MICROWAVE UNIT. REPAIR OR REPLACE.
PROBLEM IS IN A3U2 OR U3 AND ASSOC. CIRCUITRY. REPAIR OR REPLACE
MEASURE THE FOLLOWING CONTROL LINES ON THE ANALOG PCB TO INSURE THAT THEY ARE AT THE LOGIC LEVELS LISTED BELOW:
CONTROL LINE | PROPER LEVEL
RANGE CONT'L 1 | V ≥ 2.8V
RANGE CONT'L 2 | V ≤ .8V
RANGE CONT'L 6 | V ≤ .8V
RANGE CONT'L 7 | V ≥ 2.8V
3
ARE ALL 4 CONTROL LINES AT PROPER LEVELS ?
REMOVE THE IC ON THE ANALOG PCB WHICH IS CONTROLLED BY THE QUESTIONABLE CONTROL LINE
IS THE QUESTIONABLE CONTROL LINE AT THE PROPER LEVEL ?
PROBLEM IS IN THE DIGITAL PCB (U8 OR U20). REPLACE IC.
PROBLEM IS IN IC JUST REMOVED. REPLACE IC
TURN 1MW SOURCE OFF OR REMOVE DETECTOR FROM IT.
4
Y
N

Figure 4-16-4. Troubleshooting Chart for Power Meter Operation (Sheet 2 of 3)

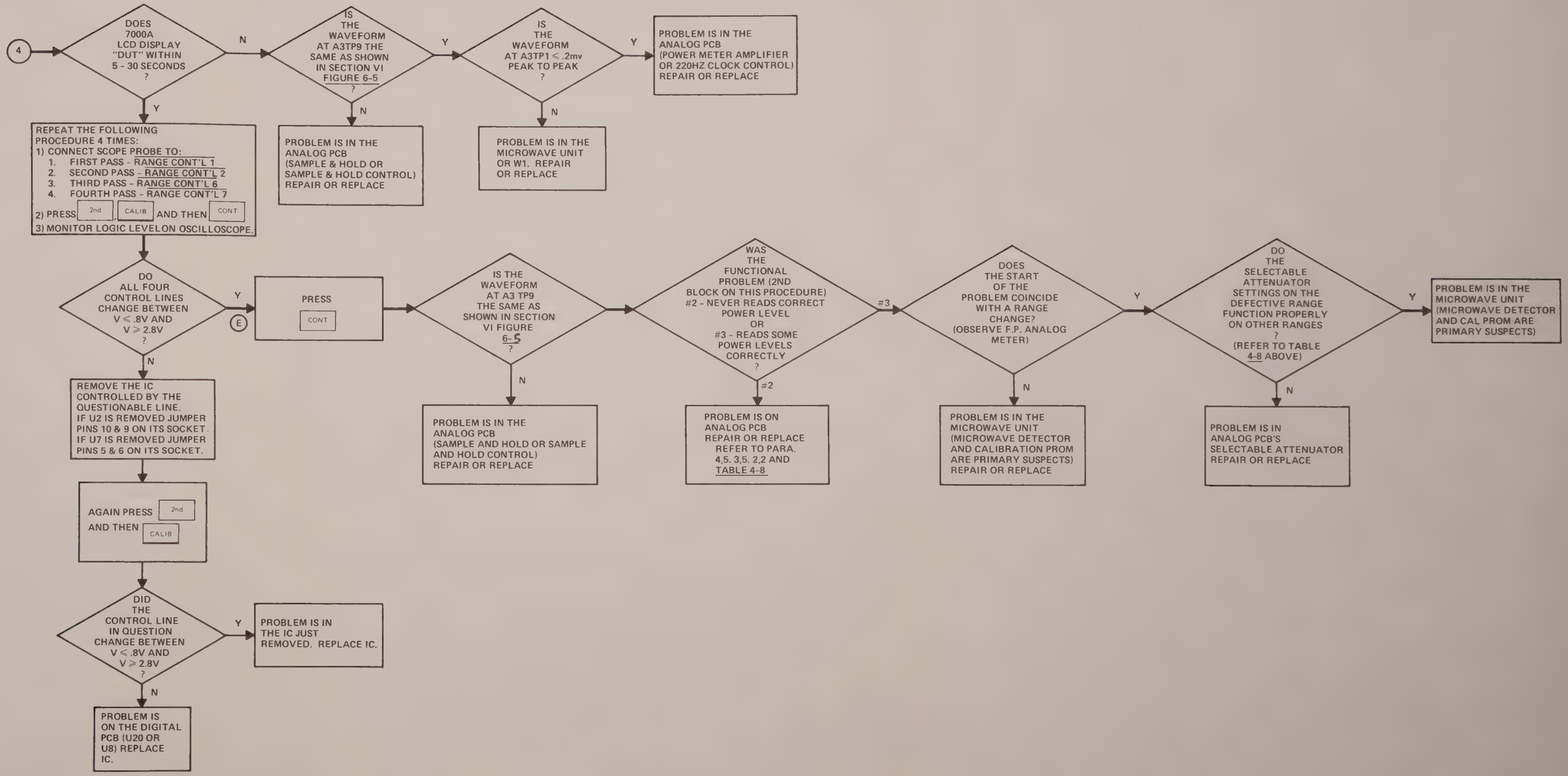

4
DOES 7000A LCD DISPLAY "DUT" WITHIN 5 - 30 SECONDS ?
N
IS THE WAVEFORM AT A3TP9 THE SAME AS SHOWN IN SECTION VI FIGURE 6-5 ?
Y
IS THE WAVEFORM AT A3TP1 ≤ .2mv PEAK TO PEAK ?
Y
PROBLEM IS IN THE ANALOG PCB (POWER METER AMPLIFIER OR 220HZ CLOCK CONTROL) REPAIR OR REPLACE
N
PROBLEM IS IN THE ANALOG PCB (SAMPLE & HOLD OR SAMPLE & HOLD CONTROL) REPAIR OR REPLACE
N
PROBLEM IS IN THE MICROWAVE UNIT OR W1. REPAIR OR REPLACE
Y
REPEAT THE FOLLOWING PROCEDURE 4 TIMES:
1) CONNECT SCOPE PROBE TO:
1. FIRST PASS - RANGE CONT'L 1
2. SECOND PASS - RANGE CONT'L 2
3. THIRD PASS - RANGE CONT'L 6
4. FOURTH PASS - RANGE CONT'L 7
2) PRESS 2nd, CALIB AND THEN CONT
3) MONITOR LOGIC LEVELON OSCILLOSCOPE.
DO ALL FOUR CONTROL LINES CHANGE BETWEEN V ≤ .8V AND V ≥ 2.8V ?
Y
E
PRESS CONT
IS THE WAVEFORM AT A3 TP9 THE SAME AS SHOWN IN SECTION VI FIGURE 6-5 ?
N
PROBLEM IS IN THE ANALOG PCB (SAMPLE AND HOLD OR SAMPLE AND HOLD CONTROL) REPAIR OR REPLACE
WAS THE FUNCTIONAL PROBLEM (2ND BLOCK ON THIS PROCEDURE) #2 - NEVER READS CORRECT POWER LEVEL OR #3 - READS SOME POWER LEVELS CORRECTLY ?
#2
PROBLEM IS ON ANALOG PCB REPAIR OR REPLACE REFER TO PARA. 4,5. 3,5. 2,2 AND TABLE 4-8
#3
DOES THE START OF THE PROBLEM COINCIDE WITH A RANGE CHANGE? (OBSERVE F.P. ANALOG METER)
N
PROBLEM IS IN THE MICROWAVE UNIT (MICROWAVE DETECTOR AND CALIBRATION PROM ARE PRIMARY SUSPECTS) REPAIR OR REPLACE
Y
DO THE SELECTABLE ATTENUATOR SETTINGS ON THE DEFECTIVE RANGE FUNCTION PROPERLY ON OTHER RANGES ? (REFER TO TABLE 4-8 ABOVE)
N
PROBLEM IS IN ANALOG PCB'S SELECTABLE ATTENUATOR REPAIR OR REPLACE
Y
PROBLEM IS IN THE MICROWAVE UNIT (MICROWAVE DETECTOR AND CAL PROM ARE PRIMARY SUSPECTS)
N
REMOVE THE IC CONTROLLED BY THE QUESTIONABLE LINE. IF U2 IS REMOVED JUMPER PINS 10 & 9 ON ITS SOCKET. IF U7 IS REMOVED JUMPER PINS 5 & 6 ON ITS SOCKET.
AGAIN PRESS 2nd AND THEN CALIB
DID THE CONTROL LINE IN QUESTION CHANGE BETWEEN V ≤ .8V AND V ≥ 2.8V ?
Y
PROBLEM IS IN THE IC JUST REMOVED. REPLACE IC.
N
PROBLEM IS ON THE DIGITAL PCB (U20 OR U8) REPLACE IC.

Figure 4-16-4. Troubleshooting Chart for Power Meter Operation (Sheet 3 of 3)

FUNCTIONAL BLOCKS KNOWN GOOD FROM PRIOR TESTS	KEY	FUNCTIONAL BLOCKS JUST CHECKED: O.K.
I POWER SUPPLIES 1. +5V 2. +15V 3. -15V II FRONT PANEL ENTIRE PCB & ANALOG METER III DIGITAL PCB 1. SECTION I - INPUTS TO MICROPROCESSOR: ENTIRE SECTION 2. SECTION II - DIRECT CONTROL BY MICROPROCESSOR: ENTIRE SECTION - EXCEPT IEEE-488 OPTION 3. SECTION III - CONTROL BY MICROPROCESSOR THROUGH THE PIA A. REFERENCE VOLTAGE GEN. B. D/A CONVERTER FOR A/D CONVERSION C. LATCHING BUFFER FOR ANALOG BOARD CONTROLS D. D/A CONVERTER FOR POWER SENSOR AUTO-ZERO IV ANALOG PCB ENTIRE PCB V MICROWAVE UNIT 1. DETECTOR CALIBRATION PROM - EXCEPT CAL FACTORS 2. DIGITAL LINES TO CAL. PROM 3. DETECTOR - 220HZ CHOPPER, PREAMP & LOW FREQ. OPERATION OF MICROWAVE DIODE 4. 220HZ AMPLIFIER 5. DETECTOR ZERO CONTROL 6. 220HZ CHOPPER DRIVE	Ⓐ	DIGITAL PCB: OSC. OFF CONTROL LINE MICROWAVE UNIT: RF ON/OFF CONTROL
	Ⓑ	MICROWAVE UNIT: OSCILLATOR CALIBRATION PROM
	Ⓒ	POWER SUPPLIES: 1) VBAT } ALL 2) +40V
	Ⓓ	MICROWAVE UNIT 7100, 7300 OR 7400 SERIES: INTERNAL OSCILLATOR(S) 7200 SERIES: PIN SWITCH OPERATION

NOTE 1: THE MOST PROBABLE CAUSES OF A PROBLEM IN SIGNAL GENERATOR/SWEEP GENERATOR MODES OF OPERATION ARE IN THE MICROWAVE UNIT. HENCE, IT MAY SAVE TIME TO TEMPORARILY REPLACE THE MICROWAVE UNIT IF ANOTHER ONE IS READILY AVAILABLE TO SEE IF IT IS DEFECTIVE.

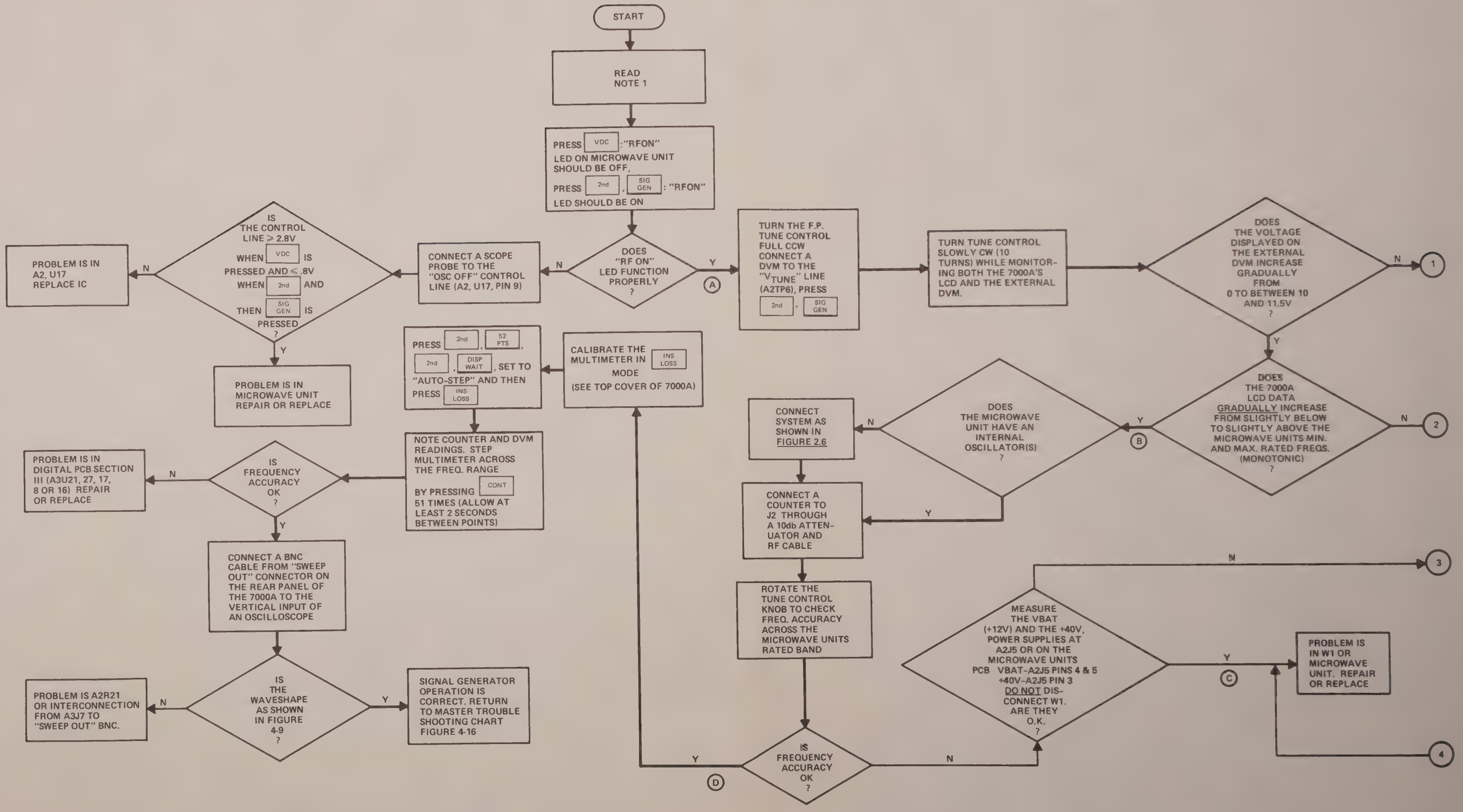

START
READ NOTE 1
PRESS VDC :"RFON" LED ON MICROWAVE UNIT SHOULD BE OFF, PRESS 2nd , SIG GEN : "RFON" LED SHOULD BE ON
DOES "RF ON" LED FUNCTION PROPERLY ?
Y
Ⓐ
N
CONNECT A SCOPE PROBE TO THE "OSC OFF" CONTROL LINE (A2, U17, PIN 9)
IS THE CONTROL LINE ≥ 2.8V WHEN VDC IS PRESSED AND ≤ .8V WHEN 2nd AND THEN SIG GEN IS PRESSED ?
N
PROBLEM IS IN A2, U17 REPLACE IC
Y
PROBLEM IS IN MICROWAVE UNIT REPAIR OR REPLACE
TURN THE F.P. TUNE CONTROL FULL CCW CONNECT A DVM TO THE "V TUNE" LINE (A2TP6), PRESS 2nd , SIG GEN
TURN TUNE CONTROL SLOWLY CW (10 TURNS) WHILE MONITORING BOTH THE 7000A'S LCD AND THE EXTERNAL DVM.
DOES THE VOLTAGE DISPLAYED ON THE EXTERNAL DVM INCREASE GRADUALLY FROM 0 TO BETWEEN 10 AND 11.5V ?
N
1
Y
DOES THE 7000A LCD DATA GRADUALLY INCREASE FROM SLIGHTLY BELOW TO SLIGHTLY ABOVE THE MICROWAVE UNITS MIN. AND MAX. RATED FREQS. (MONOTONIC) ?
N
2
Y
Ⓑ
DOES THE MICROWAVE UNIT HAVE AN INTERNAL OSCILLATOR(S) ?
N
CONNECT SYSTEM AS SHOWN IN FIGURE 2.6
Y
CONNECT A COUNTER TO J2 THROUGH A 10db ATTENUATOR AND RF CABLE
ROTATE THE TUNE CONTROL KNOB TO CHECK FREQ. ACCURACY ACROSS THE MICROWAVE UNITS RATED BAND
IS FREQUENCY ACCURACY OK ?
N
MEASURE THE VBAT (+12V) AND THE +40V, POWER SUPPLIES AT A2J5 OR ON THE MICROWAVE UNITS PCB VBAT-A2J5 PINS 4 & 5 +40V-A2J5 PIN 3 DO NOT DISCONNECT W1. ARE THEY O.K. ?
N
3
Y
Ⓒ
PROBLEM IS IN W1 OR MICROWAVE UNIT. REPAIR OR REPLACE
4
Y
Ⓓ
CALIBRATE THE MULTIMETER IN INS LOSS MODE (SEE TOP COVER OF 7000A)
PRESS 2nd , 52 PTS , 2nd , DISP WAIT , SET TO "AUTO-STEP" AND THEN PRESS INS LOSS
NOTE COUNTER AND DVM READINGS. STEP MULTIMETER ACROSS THE FREQ. RANGE BY PRESSING CONT 51 TIMES (ALLOW AT LEAST 2 SECONDS BETWEEN POINTS)
IS FREQUENCY ACCURACY OK ?
N
PROBLEM IS IN DIGITAL PCB SECTION III (A3U21, 27, 17, 8 OR 16) REPAIR OR REPLACE
Y
CONNECT A BNC CABLE FROM "SWEEP OUT" CONNECTOR ON THE REAR PANEL OF THE 7000A TO THE VERTICAL INPUT OF AN OSCILLOSCOPE
IS THE WAVESHAPE AS SHOWN IN FIGURE 4-9 ?
N
PROBLEM IS A2R21 OR INTERCONNECTION FROM A3J7 TO "SWEEP OUT" BNC.
Y
SIGNAL GENERATOR OPERATION IS CORRECT. RETURN TO MASTER TROUBLE SHOOTING CHART FIGURE 4-16

Figure 4-16-5. Troubleshooting Chart for Signal Generator Operation (Sheet 1 of 2)

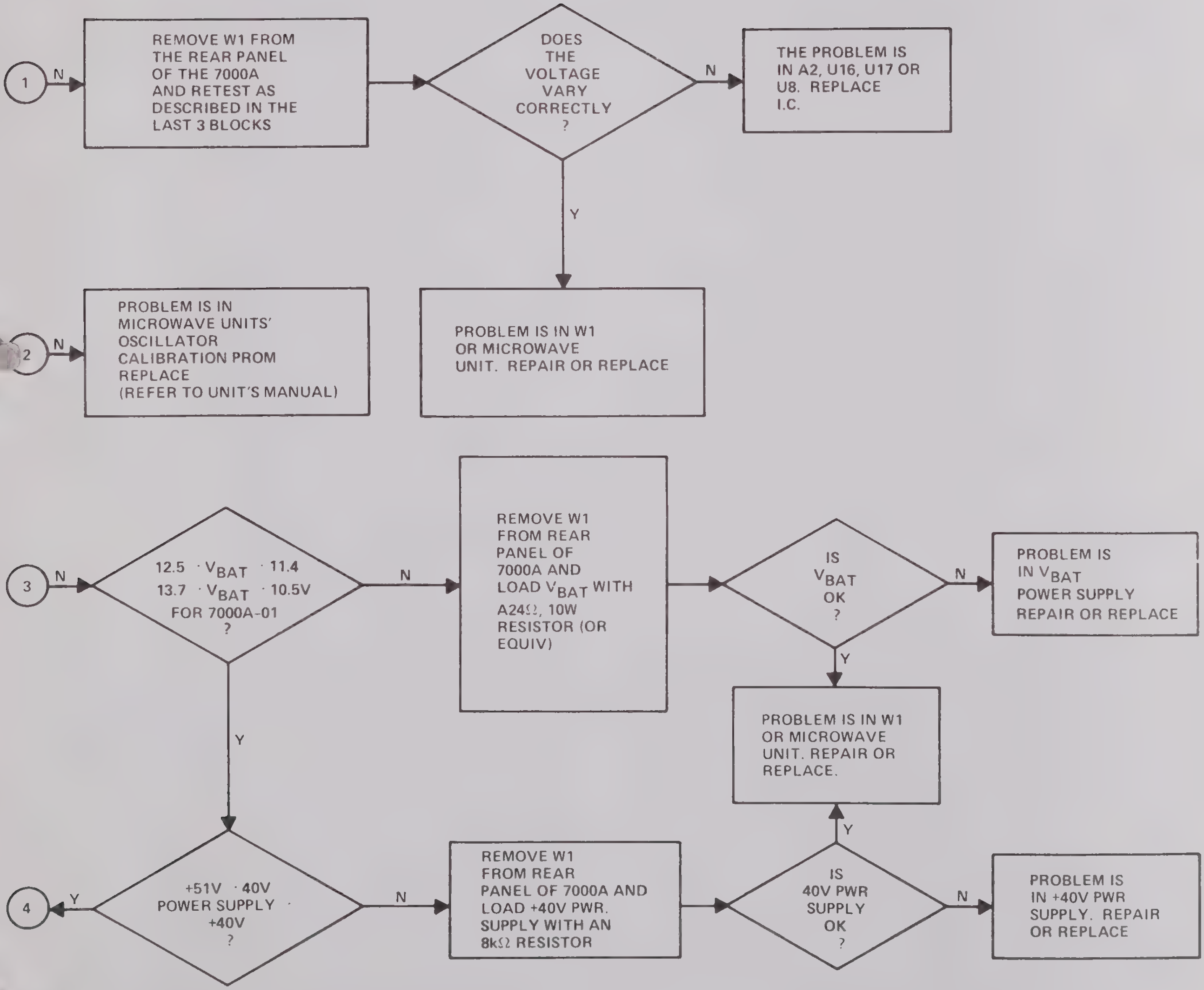

1
N
REMOVE W1 FROM THE REAR PANEL OF THE 7000A AND RETEST AS DESCRIBED IN THE LAST 3 BLOCKS
DOES THE VOLTAGE VARY CORRECTLY ?
N
THE PROBLEM IS IN A2, U16, U17 OR U8. REPLACE I.C.
Y
PROBLEM IS IN W1 OR MICROWAVE UNIT. REPAIR OR REPLACE
2
N
PROBLEM IS IN MICROWAVE UNITS' OSCILLATOR CALIBRATION PROM REPLACE (REFER TO UNIT'S MANUAL)
3
N
12.5 · VBAT · 11.4
13.7 · VBAT · 10.5V
FOR 7000A-01 ?
N
REMOVE W1 FROM REAR PANEL OF 7000A AND LOAD VBAT WITH A24Ω, 10W RESISTOR (OR EQUIV)
IS VBAT OK ?
N
PROBLEM IS IN VBAT POWER SUPPLY REPAIR OR REPLACE
Y
PROBLEM IS IN W1 OR MICROWAVE UNIT. REPAIR OR REPLACE.
Y
4
Y
+51V · 40V POWER SUPPLY · +40V ?
N
REMOVE W1 FROM REAR PANEL OF 7000A AND LOAD +40V PWR. SUPPLY WITH AN 8kΩ RESISTOR
IS 40V PWR SUPPLY OK ?
Y
N
PROBLEM IS IN +40V PWR SUPPLY. REPAIR OR REPLACE

Figure 4-16-5. Troubleshooting Chart for Signal Generator Operation (Sheet 2 of 2)

SECTION V

MICROWAVE MULTIMETER REPLACEABLE PARTS INFORMATION

NARDA Model 7000A and 7000A-01

5.1. INTRODUCTION.

This section provides ordering and repair service information, a list of suppliers and a replaceable parts list for Narda's Model 7000A and 7000A-01 microwave multimeter.

5.2. ORDERING INFORMATION.

To order replacement parts for the multimeter, contact the sales department at:

5.2.1. Narda Microwave Corp.
435 Moreland Rd.
Hauppauge, N.Y. 11788
Phone 516 - 231-1700 TWX 510-221-1867

5.2.2. When ordering replacement parts, supply the following information:
Model and serial number of the equipment
Narda part number
Reference designator
Description.

5.2.3. When ordering components or parts not listed in Table 5-2 a complete description of the part including its function and location should be provided with the model number and serial number of the instrument. State the quantity required when ordering parts.

5.3. CUSTOMER REPAIR SERVICE.

Repair and recalibration of Narda products is performed by the customer service department at the Narda facility shown under paragraph 5.2. It is suggested that you contact Narda Microwave Corp. or your local Narda sales representative for shipping instructions, or with maintenance information requests.

5.4. LIST OF SUPPLIERS.

Table 5-1 identifies suppliers listed in numerical sequence according to their manufacturers supply code number.

Table 5-1
Manufacturer's Code

MANUFACTURER'S SUPPLY CODE	NAME	ADDRESS
00213	Sage Electronics Corp.	P.O. Box 3926 Rochester, NY 14610
00328	Stock Drive Products	55 S. Denton Ave. New Hyde Park, N.Y. 11040
00779	Amp Inc.	P.O. Box 3608 Harrisburg, Pa. 17105
01121	Allen-Bradley Co.	1201 South 2nd St. Milwaukee, Wis. 53204
01295	Texas Instruments Inc. Semiconductor & Components Division	13500 North Central Expressway Dallas, Tex. 75231
01884	Dearborn Electronics Inc.	P.O. Box 1076 Longwood, Fla.
02811	Metalphoto Corp.	18531 South Miles Rd. Cleveland, Ohio 44128
04713	Motorola Semiconductor Products Inc.	5005 East McDowell Road Phoenix, Ariz. 85008

Table 5-1 (Cont)

MANUFACTURER'S SUPPLY CODE	NAME	ADDRESS
05972	Loctite Corp.	75 N. Mountain Rd. Newington, Ct. 06111
06383	Panduit Corp.	17301 Ridgeland Ave. Tinley Park, Ill. 60477
06540	Amatom Elec. Div. Mite Corp.	466 Blake St. New Haven, Ct. 06515
07716	IRC Division of TRW Inc. Burlington Plant	2850 Mt. Pleasant Burlington, Iowa 52601
09353	C & K Components, Inc.	103 Morse Street Watertown, Ma 02172
14099	Semtech Corp.	652 Mitchell Road Newbury Park, Ca. 91320
14655	Cornell-Dubilier Electronics Division Federal Pacific Electric Co.	50 Paris St. Newark, NJ 07105
14936	General Instruments	600 W. John St. Hicksville, N.Y. 11802
15238	ITT Semiconductor	470 Broadway Lawrence, Mass. 01841
15912	Ansley Electronics Corp.	3208 Humboldt St. Los Angeles, Ca. 90031
17325	3 M Company	15 Henderson Drive West Caldwell, N.J. 07006
19209	General Electric	P.O. Box 114 Gainsville, Fla. 32602
22526	Berg Electronics Div. of E.I. du Pont de Nemours & Co., Inc.	New Cumberland, Pa. 17070
24335	Analog Devices	P.O. Box 280 Norwood, Ma 02062
27014	National Semi-Conductor Corp.	2950 San Ysidro Way Santa Clara, Ca. 95051

Table 5-1 (Cont)

MANUFACTURER'S SUPPLY CODE	NAME	ADDRESS
27982	Semiconductor Circuits, Inc.	218 River Street Haverhill, Ma 01830
31433	Union Carbide Corp. Electronics Division Components Dept.	Highway 276 SE Greenville, SC 29606
32171	Modutec Inc.	13 Marshall St. Norwalk, Ct. 06854
33809	Texas Instruments Inc.	P.O. Box 5012 13500 North Central Expressway Dallas, Texas 75222
46384	Penn Engrg & Mfg. Corp.	Doylestown, Pa. 18901
49671	R.C.A.	Deptford, N.J. 08096
56289	Sprague Electric Co.	North Adams, Mass. 01247
70318	Allmetal Screw Products Co.	Garden City, N.Y. 11530
71279	Cambridge Thermionic Corp.	445 Concord Ave. Cambridge, Mass. 02138
71400	Bussmann Mfg. Division of McGraw & Edison Co.	2536 W. University St. St. Louis, Mo. 63017
71530	Centralab Elec. Div.	Ft. Dodge, Iowa 50501
71984	Dow Corning Corp.	S. Saginaw Rd. Midland, Mich. 48640
72136	Electro Motive Mfg., Co., Inc.	The South Park and John Streets, Willimantic, Conn. 06226
72982	Erie Technological Products, Inc.	644 W. 12th St. Erie, Pa. 16512
73803	Texas Instruments Connector Systems	34 Forest St. Attleboro, Ma. 02703
75378	CTS Knights, Inc.	400 Reimann Ave. Sandwich, Ill. 60648

Table 5-1 (Cont)

MANUFACTURER'S SUPPLY CODE	NAME	ADDRESS
75912	Littlefuse Inc.	800 E. Northwest Highway Des Plains, Ill. 60016
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco, Inc.	Morristown, N.J. 07960
80294	BOURNS, Inc. Dept. EM Trimpot Products Div.	1200 Columbia Ave. Riverside, Ca. 92507
81073	Grayhill, Inc.	569 Hillgrove Ave. La Grange, Ill. 60525
82389	Switchcraft Inc.	555 N. Elston Ave. Chicago, Ill. 60630
83330	H.H. Smith	812 Snediker Ave. Brooklyn, N.Y. 11207
90484	ITT Suprenant Div.	172 Sterling St. Clinton, Ma. 01510
91345	Miller Dial & Nameplate Div. of Standard International Corp.	4400 N. Temple City Blvd. El Monte, Ca.
91637	Dale Electronics Inc.	P.O. Box 609 Columbus, Nebr. 68601
91833	Keystone Electronics	49 Bleecker St. New York, N.Y.
91836	Kings Electronics Co. Inc.	40 Marbledale Rd. Tuckahoe, N.Y. 11223
92194	Alpha Wire Corp.	711 Lidgewood Ave. Elizabeth, N.J. 07207
92702	IMC Magnetics Corp. Eastern Division	570 Main St. Westbury, Long Island, NY 11591
93958	Mucon Div. Republic Electronics	176 E. 74th St. Paterson, N.J. 07524
95275	Vitramon	Box 544 Bridgeport, Ct. 06601

Table 5-1 (Cont)

MANUFACTURER'S SUPPLY CODE	NAME	ADDRESS
96733	San Fernando Electric Mfg. Co.	1501 First St. San Fernando, Ca. 91341
99899	Narda Microwave Corp.	75 Commercial St. and Terminal Dr. Plainview, LI, NY 11803

5.5 REPLACEABLE PARTS LIST.

Parts listed in Table 5-2 can be located by referring to the parts location drawings, located in Section VI of this manual.

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY.
A1	FRONT PANEL ASSY	99899	212292	212292 J	1
	. PCB ASSY FRONT PANEL	99899	105620	105620 H	1
	. . PCB FABRIC-ARTWORK-MARKING		105621	105621 B	1
	. . LOCTITE	05972	LOCTITE GUIDE C	410187	
	. . SHIELD, TERMINAL	99899	418038	418038 C	1
	. . SOCKET, REWORK DEG AGREES SOCKET STRIP 30 PIN	99899	418039	418039 C	2
	. . SCR. FIL HD CROSS RECESSED 0=80, x 3/16 LO	70310	SCR FIL HD CROSS RECESSED 8-80	70103003 C	2
A1C1	. . CAP. . .01 , 25V	72982	5835-000 Y5U103Z	80123006	1
A1C2, A1C3 & A1C4	. . CAP, 4.7UF, 10V, 10%	56289	CAP 4.7UF, 10V, 10%, NARDA SCD 80230020	80230020 B	3
A1R1 & A1R2	. . RES. 1K OHM, 1/4W, 5%	01121	RC07GF471T	83015049 E	2
A1R3	. . RES. .68 MEG OHM, 1/4W, 5%	01121	RC07GF684T	83015117 E	1
A1R4	. . RES. 4120 OHM, 1/8W, 1%	07716	CEA-TO	83049251 F	1
A1S1 through A1S8 & A1S14, A1S16	. . SWITCH SPST MOM	71590	K40111AA	83728000	10
A1S13	. . SWITCH, ROCKER, WHT	09353	7101-J1-V4-WHT(1) ROCKER	83729001 C	1
A1S17	. . SWITCH, ROCKER, BLK	09353	7201-J1-V4-BLK(2) ROCKER	83729002 C	1
A1U4	. . I.C. CD4047BE (14 PIN)	49671	CD4047BE	84818047 B	1
A1U2 & A1U3	. . IC MD4332BS (40 PIN)	99899	84821000	84821000 A	2
A1E3 through A1E8	. . TERMINAL TUBULAR	91833	1562-2	87118002 A	8
A1P1 & A1P2	. . FLEXIBLE FLAT CABLE ASSY 13 CONTACT 3 AMP 4"	00779	1-86945-2	87203000 A	2
	. . IC SOCKET 14 PIN	73803	C93-14-10	89075001	1
	. . IC SOCKET 40 PIN	73803	C93-40-10	89075008 C	2
	. . INSUL VARNISH	71984	3140RTV	93666000	
	. BLUE BUTTON dBM at 12 PTS - HOT STAMP	99899	213161	213161 B	1

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A1	. . BUTTON, SWITCH			83730010 D	1
	. BLUE BUTTON - uW/MW at 52 PTS - HOT STAMP	99899	213162	213162 B	1
	. . BUTTON, SWITCH			83730010 D	1
	. BLUE BUTTON, HOT STAMP INS. LOSS & SIG. GEN.	99899	213163	213163 B	1
	. . BUTTON, SWITCH			83730010 D	1
	. BLUE BUTTON, - HOT STAMP VDC & SWEEP GEN	99899	213164	213164 B	1
	. BLK BUTTON, - RTN LOSS & MIN/MAX - HOT STAMP	99899	213165	213165 B	1
	. BLK BUTTON, - VSWR & DISP STEP - HOT STAMP	99899	213166	213166 B	1
	. BLK BUTTON, RHO & DISP WAIT - HOT STAMP	99899	213167	213167 B	1
	. BLK BUTTON, - 2ND HOT STAMP	99899	213168	213168 B	1
	. GRAY BUTTON, CONT & CALIB - HOT STAMP	99899	213169	213169 B	1
	. GRAY BUTTON, - FREQ DISP & ENTER - HOT STAMP	99899	213170	213170	1
	. FR PANEL ASSY	99899	317927	317927 A	1
	. . . STUD #4 x 3/8 LG	46384	F-0428-5	70505012	1
	. . . STANDOFF #4 x 7/8 LG	46384	B505-440-22	72009005	6
	. . . STANDOFF SELF CLINCHING	46384	B505-440-24	72009010 H	3
	. SWITCH & POT ASSY	99899	318810	318810 B	1
	. . PLATE, SWITCH & POTEN.	99899	318810	318780 A	1
	. . RES, VAR 10K OHM	80394	84C1A-E24-J15	83266001	1
	. . SWITCH, MOMENTARY PUSH	01121	20N1478	83736000 A	1
	. . SPUR GEAR	00328	IT2-RL6096	92565000 B	2
	. EASTMAN 910				
	. PLATE, METER	99899	417612	417612 A	1
	. SPACER, METER	99899	417882	417882 A	2
	. CONN HOUSING 3 PIN	00779	87499-5	81774006	1
	. CONTACT	00779	86016-2	81775002	3
	. KEY	00779	87077-2	81786001	1
	. JACK, INSULATED	83330	221-102	81810000 A	1
	. JACK, INSULATED	83330	221-103	81810001 A	1
	. METER, EDGE READING	32171	MD-DMA-001-2	82538000 B	1
	. LCD DISPLAY	12617	PER NARDA SCD 84811000	84811000 G	1

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A1	. LUG, TERMINAL	79963	PER NARDA SCD 87116001	87116001	1
	. WIRE 22 AWG, WHITE TEFLON	92914	WIRE WHT. TEFLON 72 AWG	89611009 C	
	. WIRE 26 AWG, GREEN	92914	WIRE 26 AWG GREEN	89623004 A	
	. WIRE 26 AWG, ORANGE	92914	WIRE 26 AWG ORANGE	89623008 A	
	. WIRE HOOK-UP 20, AWG RED	92914	WIRE HOOK-UP #20 RED	89666002	
	. WIRE HOOK-UP 20, AWG BLK	92914	WIRE HOOK-UP #20 BLK	89666010	
	. KNOB	99899	93082000	93082000 A	1
	. KNOB CAP	99899	93082001	83082001 A	1
	. KNOB SKIRT	99899	93082002	93082002 A	1
	. ADHESIVE	99899	93642000	93642000	
	. WASHER, FLAT #4	70318	MS5795803	515795803	8
	. LOCK WASHER INT 1/4	70318	MS5333074	535333074	2
	. LOCKWASHER #4	70318	MS5338135	535338135	8
	. NUT	70318	MS5649244	535649244	2
	. SCR. PAN HD 4-40 x 1/4 LG	70318	MS1957013	551957013	6
	. SCR. PAN HD 4-40 x 3/8 LG	70318	MS1957015	551957015	2
A2	PCB ASSY, DIGITAL	99899	105635	105635 A	1
	. PCB FABRICATION, DIGITAL			105649 F	1
A2U12	(NOT USED)				
A2U13	. INTEG CIR PROGRAMMED	99899	32307800	32307800 A	1
A2U14	. INTEG CIR PROGRAMMED	99899	32307900	32307900 A	1

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT	MFG. PART NO.	NARDA PART NO.	QTY
A2U15	. INTEG CIR PROGRAMMED	99899	32308000	32308000 A	1
	. SCR. FIL HD CROSS RECESSED 2-56, No. 2 x 3/8 LG	&)#L*	SCR. FIL HD CROSS RECESSED 2-56 NC-2 x 3/8" Lg	70103020 C	
	. SCR. FIL HD CROSS RECESSED 2-56 NC 2 x 7/16 LG	70318	SCR. FIL HD CROSS RECESSED 2-56, NC-2 x 7/16 Lg	70103021	2
	. SCR. FIL HD CROSS RECESSED 2-56 NC 2 x 5/8 LG	70318	SCR. FIL HD CROSS RECESSED 2-56 NC-2 x 5/8 Lg	70103023	2
A2C6, C8	. CAPACITOR, DIPPED MICA 27 PF	14655	CD15E270J0	80115015	2
A2C9, C10 & C11	. CAP. .001UF, 500V	14655	BYA10D2	80128001	3
A2C2, 28,29, 30	. CAP. 4.7UF, 35VDC	31433	T368B475-K035AS	80168065	4
A2C3,4, 5,12 to 13,C20, 24,26,27	. CAP. .1UF, 50V	72982	8121-050-651-104M	80214000	17
A2C7, C13	. CAP. 47UF, 20V, 10%	56289	196D476X-9020PE4	80261001	2
A2C1	. CAP .01UF, 80, 10%	56289	292P1039R8	80268002	1
A2E1	. TERM, TURRET	71279	1558-2	80607002	1
A2J3	. MALE HEADER (26 PIN)	15912	609-2632M	81779000	1
A2J4	. MALE HEADER 16 PIN)	15912	609-1632M	81779001	1
A2J6	. CONN. RECEPTACLE, RT ANGLE D TYPE 37 PIN	00779	206B17-1	81806002	1
A2J1 & J2	. DIP STRIP, LOW PROFILE (13 CONTACTS)	00779	58773-5	81808000	2

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A2J5	. CONNECTOR, 24 PIN (IEEE-488)	00779	552791-1	81809000	1
A2TP1 & TP4 through TP7 & J7	. HEADER ASSY (1 POS)	00779	65508-401	81814003	6
A2TP2 & TP3	. HEADER ASSY (2 POS)	00779	65508-402	81814004	1
A2R6	. RES. 820 OHM, 1/4W, 5%	01121	RC07GF821T	83015047	1
A2R16, R17	. RES. 1K OHM, 1/4W, 5%	01121	RC07GF102T	83015049	2
A2R3, R4 & R5	. RES. 4.7K OHM, 1/4W, 5%	01121	RC07GF472T	83015065	3
A2R21	. RES. 10K OHM, 1/4W, 5%	01121	RC07GF103T	83015073	1
A2R11	. RES. 15K OHM, 1/4W, 5%	01121	RC07GF153T	83015077	1
AOR18 & R19	. RES. 47K OHM, 1/4W, 5%	01121	RC07GF473T	83015089	4
A2R20	. RES. .10 MEG OHM, 1/4W, 5%	01121	RC07GF104T	83015097	1
A2R15	. RES. 510K OHM 1/4W 5%	01121	RC07GF514T	83015114	1
A2R13	. RES. 90.9K OHM, 1/8W, 1%	07716	CEA-70	83049379	1
A2R7	. POT CERMET MT2W502, 5K	80294	3299W-1-502	83246003	1
A2R9 & R12	. POT CERMET MT2W203, 20K	80294	232W-1-203	83246005	2
A2R1,R2 & R8	. RES NETWORK A-B108A-104	80294	329W-1-501	83264000	3
A2CR2	. DIODE IN938A	04713	1N938A	84539037	1
A U29	. IC MC14011 BCP	04713	MC14011BCP	84779000	1
A2U18, 25,27	. IC LF355N	27014	LF355N	84783000	3
A2U9	. IC SN74LS00N	04713	SN74LS00N	84798000	1
A2U23	. IC SN74LS139N	04713	SN74LS139N	84798139	1
A2U17, U20	. IC MM74C373	27014	MM74C373	84801001	2
A2U2, U22	. I.C. MC14012BCP	04713	MC14012BCP	84818012	2
A2U26	. I.C. CD4047BE	49671	CD4047BE	84818047	1
A2U1	. I.C. MC14068BCP	04713	MC14068BCP	84818068	1
A2U8	. I.C. MC14069BCP	04713	MC14069BCP	84818069	1
A2U3	. I.C. MC14077BCP	04713	MC14077BCP	84818077	1
A2U5, U6	. I.C. MC14502BCP	04713	MC14502BCP	84818502	2
A2U28	. I.C. MC14518BCP	04713	MC14518BCP	84818518	1

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A2U16	. IC, ADG200CJ	24335	ADG200CJ	84819200	1
A2U4	. IC, MC6808P	04713	MC6808P	84820000	1
A2U19, 21,24	. IC, AD7522LN	24335	AD7522LN	84822022	3
A2U10, U11	. IC, MM2114N	27014	MM2114N	84823000	2
A2U7	. IC, MC6821P	04713	MC6821P	84825000	1
A2CR1, CR3,CR4, CR5,CR6	. DIODE IN4148	15238	IN4148	84830000	5
A2CR7	. CRYSTAL 4.00 MHz	75378	MP040	87547000	1
A2Q1	. TRANSISTOR, 2N4126	04713	2N4126	89018037	1
A2XU18, 25,27	. IC SOCKET 8 PIN	73803	C93-08-10	89075000	3
A2XU1, 2,3,8,9, 16,22,26, 29, X51	. IC SOCKET 14 PIN	73803	C93-14-10	89075001	10
A2XU5, 6,23, 28,33	. IC SOCKET 16 PIN	73803	C93-16-10	89075002	5
A2XU17 & U20	. IC SOCKET 20 PIN	73803	C93-70-10	89075003	2
A2XU10 & XU11	. SOCKET 18 PIN	73803	C93-18-10	89075004	2
A2XU12, 13,14, 15,30, 31	. SOCKET 24 PIN	73803	C93-21-10	89075006	6
A2XU19, 21,24	. SOCKET 28 PIN	73803	C93-28-10	89075007	3
A2XU7, XU32, XU4	. IC SOCKET 40 PIN	73803	C93-40-10	89075008	3
	. TUBING SHRINK	92914	F17-221-1/2"	89533008	
	. FLAT WASHER NO. 2	70318	MS5795802	515795802	12
	. LOCKWASHER SPLIT, NO. 2	70318	MS5338134	535338134	8
	. NUT, HEX 2-56	70318	MS5649003	535649003	8

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A3	PCB ASSY, ANALOG	99899	1056-47	105647 J	1
	. PCB FABRICATION, ANALOG			105648 E	
A3C17	. CAP. 10PF, 5%	72136	DM15C100-J0	80115008 F	1
A3C20	. CAP. 470PF, 5%	72136	DM15E471J0	80115043	1
A3C19	. CAPACITOR, DIPPED, MICA 750 PF	72136	DM19E751J0	80115048	1
A3C22 through C31	. CAP. .1UF, 50V	72982	8121-050-651-104M	80214008	10
A3C18	. CAP, 3.3UF, 15V	56289	196D335X9015HA1	80230030	1
A3C5	. CAP. 100UF, 10V, 10%	56289	196D107X9010PE4	80261000	1
A3C1 through C4	. CAP. 47UF, 25V, 10%	56289	196D476X9035TE4	80261002	4
A3C12	. CAP, 22 UF, 10V P/M 10%	56289	196D226X9010PE4	80261010	1
A3C6 & C8	. CAP 1047UF, 80V, 10%	56289	292P4729R8	80268000	2
A3C10 & C13	. CAP .0068UF 80V 10%	56289	292P6829R8	80268001	2
A3C7	. CAP .047UF 80V 10%	56289	292P4739R8	80268003	1
A3C9 & C11	. CAP .056UF 80V 10%	56289	292P5639R8	80268004	2
A3C21	. CAP .1UF 80V 10%	56289	292P1049R8	80268005	1
A3C15 & C16	. CAP .47UF 200V 20%	56289	277P47402A1	80269005	2
A3J3	. CONNECTOR, TRANSITION 26 PIN (DWG CALLS IT PCB CONN)	15912	609-2603	81777000	1
A3J1	. CONN, TRANSITION 10 PIN (DWG CALLS IT PCB CONN)	15912	609-1003	81777002	1
A3P3	. CONNECTOR	15912	609-2601M	81778000	1
A3P1	. SOCKET CONN CONN FEMALE SOCKET, 10 PIN	15912	609-1001M	81778002	1

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A3	. POLARIZING KEY	15912	609-0000	81787000	2
A3J4	. HEADER RT ANGLE 3 POS	00779	87232-3	81790002	1
	. PULL TAB CONN	17325	3490-2	81793000	1
	. PULL TAB CONN	17325	3400-1	81793001	1
A3TP1, TP2, TP3	. HEADER ASSY 1 POS HEADER ASSY 1 PIN	22526	65508-401	81814003	1
A3TP4 TO TP8 &TP9 TO TP13	. HEADER ASSY 5 POS HEADER ASSY 5 PIN	22526	65508-405	81814005	1
A3R1 & R2	. RES. 100 OHM, 1/4W, 5%	01121	RC07GF101T	83015025	2
A3R55	. RES. 1K OHM, 1/4W, 5%	01121	RC07GF102T	83015049	1
A3R52	. RES. 1.1K, 1/4W, 5%	01121	RC07GF112T	83015050	1
A3R38	. RES. 3.9K OHM, 1/4W, 5%	01121	RC07GF392T	83015063	1
A3R49	. RES. 7.5K OHM, 1/4W, 5%	01121	RC07GF752T	83015070	1
A3R30 & R41	. RES. 15K OHM, 1/4W, 5%	01121	RC07GF153T	83015077	2
A3R29, R35,R40 & R45	. RES. 27K OHM, 1/4W, 5%	01121	RC07GF273T	83015083	4
A3R31, R42 & R43	. RES. 47K OHM, 1/4W, 5%	01121	RC07GF473T	83015089	3
A3R34, R44 & R39	. RES. .10 MEG OHM, 1/4W, 5%	01121	RC07GF104T	83015097	3
A3R54	. RES. .33 MEG OHM, 1/4W, 5%	01121	RC07GF220T	83015109 E	1
A3R24	. RES. .47 MEG OHM, 1/4W, 5	01121	RC07GF474T	83015113	1
A3R50	. RES. 1 MEG OHM, 1/4W, 5%	01121	RC07GF105T	83015121	1
A3R51	. RES RCC7 8.2 M OHMS	01121	RC07GF925T	83015143	1
A3R22	. RES RN60D 453K OHMS 1%	80031	FE12	83048446	1
A3R5	. RES 549 OHMS 1% RN55D	80031	FE10	83049168	1
A3R11 & R15	. RES RN55D 1.4K OHMS 1%	80031	FE10	83049206	2
A3R12 & R16	. RES RN55D 51.1K OHMS 1%	80031	FE10	83049355	2
A3R48	. RES. 53.6K OHM, 1/8W, 1%	80031	FE10	83049357	1
A3R6	. RES RN55D 75K OHMS 1%	80031	FE10	83049371	1
A3R46	. RES. 200K OHM, 1%	80031	FE10	83049412	1
A3R3	. RES RN55E 25.5K OHM .1%	07716	RN55E2552B	83139009	1
A3R4 & R10	. RES RN55E 100 OHM .1%	07716	RN55E1000B	83139010	2
A3R8	. RES RN55E 19.3 OHM .1%	07716	RN55E1932B	83139011	1
A3R9	. RES RN55E 6.34K OHM .1%	07716	RN55E6341B	83139012	1
A3R13	. RES RN55E 20K OHM .1%	07716	RN55E2002B	83139013	1

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A3R14	. RES RN55E 6.65K OHM 1%	07716	RN55E6651B	83139014	1
A3R26, R32, R33 & R36	. RES RN55E 100K OHMS .1%	07716	RN55E1003B	83139015	4
A3R27 & R20	. RES RN55E 1 MEG OHM .1%	07716	RN55E1004B	83139016	2
A3R18, R19 & R21	. RES RN55E 499K OHM .1%	07716	RN55E4993B	83139017	3
A3R25	. RES RN55E 9.88K OHM .1%	07716	RN55E9881B	83139018	1
A3R7	. POT CERMET MT2W502, 5K	80294	3299W-1-502	83246003	1
A3R47	. POT CERMET MT2W103, 10K	80294	3299W-1-103	83246004	1
A3R28 & R37	. POT CERMET MT2W203, 20K	80294	3299W-1-203	83246005	2
A3R23	. POT CERMET MT2W104, 100K	80294	3299W-1-104	83246006	1
A3R53	. POT CERMET MT2W101, 100 OHM	80294	3299W-1-101	83246009	1
A3CR14, & CR15	. DIODE, IN753	01295	IN753	84511008	2
A3CR16	. DIODE IN746A	02195	IN746A	84513001	1
A3U1,3, 6,8,12, 14,15	. IC LF355N	27014	LF355N	84783000	7
A3U3, U10,U11	. IC, AD7512DIJN	24335	AD7512DIJN	84819012	3
A3U2, U4,U5, U7,U13	. IC ADG200CJ	24335	ADG200CJ	84819200	5
A3CR3 through 13,17, 18	. DIODE IN4148	15238	IN4148	84830000	13
A3Q1 & Q6	. TRANSISTOR, 2N4124	04713	2N4124	89018036	2
A3Q2 & Q4	. TRANSISTOR, 2N4126	04713	2N4126	89018037	2
A3Q3 & Q5	. TRANSISTOR, 2N5638	04713	2N5638	89018103	2
A3XU1, 3,6,8, 12,14, 15	. IC SOCKET 8 PIN	73803	C93-08-10	89075000	7
A3XU2,4, 5,7,9, 10,11,13	. IC SOCKET 14 PIN	73803	C93-14-10	89075001	8

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A3	. RIBBON CABLE	15912	171-26	89661000	
	. CABLE, RIBBON 10	15912	171-10	89661001	
W1	CABLE ASSY 2 1/2 FT. LG.	99899	319067	319067	1
	SCREW LOCK ASSY	15912	609-005	81811000	1
	TEST LEAD KIT	83330	610	81813000	1
	POWER CORD	99899	89603005	89603005	1
	WIRE HOOK-UP #20 RED	99414	WIRE, HOOK-UP #20 RED	89666002	
	WIRE HOOK UP #26 ORN	99414	WIRE, HOOK-UP #20 ORN	89666008	
	WIRE HOOK-UP #20 WHT	99414	WIRE, HOOK-UP #20 WHT	89666009	
	WIRE HOOK-UP #20 BLK	99414	WIRE, HOOK-UP #20 BLK	89666010	
MP1	SCREW	99899	95630008	95630008	4
MP2	HANDLE	99899	95630009	95630009	1
MP3	CAP	99899	95630010	95630010	2
MP4	BUTTON	99899	95630011	95630011	2
MP5	SPRING	99899	95630012	95630012	2
MP6	SCREW	99899	95630013	95630013	2
MP7	SPACER	99899	95630014	95630014	8
MP8	FEET	99899	95630015	95630015 E	4
	WASHER, FLAT #4	70318	MS5795803	515795803	12
	LOCKWASHER #4	70318	MS5338135	535338135	8
	SCR. PAN HD. 2-56 x 3/8 LG.	70318	MS1957005	551957005	2
	SCR. PAN HD. 4-40 x 5/16 LG.	70318	MS1957014	551957014	8
MP9	TOP COVER ASS'Y	99899	212783	212783	1
MP10	SIDE EXPANDER	99899	212780	212780	1
MP11	SIDE EXPANDER	99899	212787	212787	1

"End of Common Parts for 7000A and 7000A-01"

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A4	PWR SUPPLY ASSY AC-DC	99899	212776	212776	1
	. PCB ASSY, PWR SUP AC-DC FOR MODEL 7000A	99899	105650	105650 B	1
	. . PCB FABRICATION PWR SUP BD			105651 D	1
A4C6, 7,9,10, 12,13, 15,16	. . CAP. . 1UF, 25V	72982	5815-000Y5U1Q42	80123009 A	8
A4C18	. . CAP. .1UF, 50V	95275	CK05BX104K	80187074 G	1
A4C8, C11,C14	. . CAP. 22UF, 35V, 10%	56289	196D226X9035-PE4	80261003	3
A4 17	. . CAP 22UF 10V 10%	56289	196D226X9010-PE4	80261010 E	1
A4C5, C19	. . CAP 15UF, 35V	56289	34D156F075EE5-EPOXY SEAL	80273000	2
A4C1, C2	. . CAP 300UF 30V	56289	34D307G030HE5-EPOXY SEAL	80273001	2
A4C3	. . CAP 1400 UF 25V	56289	34D148G025HP5-EPOXY SEAL	80273002	1
A4C4	. . CAP 5000 UF 15V	56289	34D508G015JT5-EPOXY SEAL	80273003	1
A4E1-E10, TP1-TP6	. . TERM. TURRET	71279	1558-2	80607002 A	16
A4J4	. . CONN PCB 16 CONT	15912	609-1603	81777001 B	1
A4P4	. . CONN SOCKET 16 CONT	15912	609-1601M	81778001 B	1
A4J1	. . CONNECTOR, LOW PROFILE HEADER	15912	609-1027	81779003 B	1
	. . POLARIZING KEY	15912	6090000	81787000 A	1
	. . PULL TAB CONN	17325	3490-1	81793001 B	1
A4R1	. . RES. 390 OHM, 1/4W, 5%	01121	RC07GF391T	83015039 E	1
A4CR6	. . DIODE ZENER IN4756	04713	IM47ZS10	84539028 A	1
A4CR5	. . DIODE IN 4005	33809	IN4005	84568005 A	1
A4U2	. . INT. CIRCUIT MC7915CT	04713	MC7915CT	84803000 A	1
A4U4	. . IC MC7805CT	04713	MC7805CT	84835000 B	1
A4U3	. . IC MC7812CT	04713	MC7812CT	84835001 B	1
A4U1	. . IC MC7815CT	04713	MC7815CT	84835002 B	1
A4CR1, CR2	. . BRIDGE RECTIFIER SBR1	14099	SBR1	84836000 A	2
A4CR3, CR4	. . SILICON BRIDGE RECTIFIER	14099	3SBM05	84837000 A	2
	. . CABLE, RIBBON 16	15912	171-16	89661002	
	. REAR PANEL, BOT. FOR 7000A	99899	212769	212769	1
	. BOTTOM COVER RWK AC-DC	99899	212790	212790	1
	. . BOTTOM COVER	99899	95630006	95630006	1
	. BRACKET, TRANSF	99899	418109	418109	2

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A4	. SCR SELF TAP #4-40 x 5/16	70318	SCR SELF TAP #4-40 x 5/16	70135001	4
	. SPACER	06540	8573-SS-0632-7	72026000	4
A4F1	. FUSE, 1/4 AMP, 3AG	75912	313.250	81002010	1
A4J1	. REC BNC UG-1094/U	91836	UG1094/U	81524000 F	1
	. CONN. AND FUSE ASSY	99899	81773000	81773000	1
	. CONTACT	00779	86016-2	81775002	1
A4T1	. TRANSFORMER, POWER	99899	8404900	84049000	1
	. LUG	99899	87104003	87104003	1
	. WIRE, TEFLON AWG 22 DK BLU	99899	89611013	89611013	
	. WIRE WHT/BLK TEFLON #22	90484	A2509-11	89611014	
	. WIRE TEFLON	90484	A2509-12	89611015	
	. WIRE STRANDED #22 AWG	92914	WIRE STRANDED #22 AWG	89611016	
	. WIRE STRANDED #22 AWG	92914	WIRE STRANDED #22 AWG	89611017	
	. WIRE STRANDED #22 AWG	92914	WIRE STRANDED #22 AWG	89611018	
	. WIRE STRANDED #22 AWG	92914	WIRE STRANDED #22 AWG	89611019	
	. WIRE STRANDED #22 AWG	92914	WIRE STRANDED #22 AWG	89611020	
	. WIRE STRANDED #22 AWG	92914	WIRE STRANDED #22 AWG	89611021	
	. WIRE STRANDED #22 AWG	92914	WIRE STRANDED #22 AWG	89611022	
	. WIRE STRANDED #20 AWG	92914	WIRE STRANDED #20 AWG	89666001	
	. WIRE STRANDED #20 AWG	92914	WIRE STRANDED #20 AWG	89666004	
	. WIRE STRANDED #20 AWG	92914	WIRE STRANDED #20 AWG	89666005	
	. WIRE, STRANDED #20 AWG	92914	WIRE, STRANDED #20 AWG	89666007	
	. WIRE HOOK-UP #20 WHT	92914	WIRE, HOOK-UP #20 WHT	89666009	
	. WIRE HOOK-UP #20 BLK	92914	WIRE, HOOK-UP #20 BLK	89666010	
	. WIRE STRANDED #20 AWG	92914	WIRE, STRANDED #20 AWG	89666014 A	
	. WIRE STRANDED #20 AWG	92914	WIRE, STRANDED #20 AWG	89666019 A	
	. COMPOUND, HEAT SINK	71984	DOW CORNING 340	92609000 A	
	. WASHER, FLAT #4	70318	MS5795803	515795803	4
	. FLAT WASHER #6	70318	MS5795805	515795805	8
	. LOCKWASHER #4	70318	MS5338135	535338135	4

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A4	. LOCKWASHER #6	70318	MS5338136	535338136	8
	. NUT, HEX 4-40	70318	MS5649007	535649007	2
	. SCR. PAN HD 4-40 x 1/4 LG	70318	MS1957013	551957013	2
	. SCR. PAN HD 4-40 x 3/8 LG	70318	MS1957015	559157015	2
	. SCR. PAN HD 6-32 x 7/16 LG	70318	MS1957029	551957029	4
	. SCR. PH HD. 6-32 x 1 LG.	70318	MS1957034	551957034 H	2
	. SCR. PAN HD 6-32	70318	MS1957035	551957035 H	2
	REAR PANEL SUB ASSY. TOP FOR 7000A	99899	318912	318912	1
	. REAR PANEL, TOP FOR 7000A	99899	212780	212780	1
	. CONTACT STRIP			418501 A	1
	. RIVET	70318	MS0450209	520450209	2

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A4	PCB ASSY, PWR SUP BAT FOR MODEL 7000A-01 (BAT. OP.)	99899	106121	106121 F	1
A4C5	. CAP. 100PF, 5%	72136	DM15E101J0	80115027 F	1
A4C14	. CAP. .01UF, 25V	72982	5835-00Y5U1032Z	80123006 A	1
A4C1, C3	. CAP, .1MF, 25V	72982	5835-000Y5U104Z	80123009	2
A4C6 TO C13	. CAP. .1UF, 50V	95275	CK05BX104K	80187074	8
A4C2,4, 15,16, 17	. CAP, 47MFD, 25V, 10%	56289	196D476X9035TE4	80261002	5
A4F1	. FUSE 2AMP, WUICK ACTING	75915	312002	81001016 A	1
A4XF1	. FUSE CLIP	71400	1A119-05	81016000	2
A4J4	. CONN PCB 16 CONT	15912	609-1603	81777001 B	1
A4P4	. CONN SOCKET 16 CONT	15912	609-1601M	81778001 B	1
A4J1	. MA66 HEADER, LOW PROFILE 10 PIN	15912	609-1027	81779003	1
	. POLARIZING KEY	15912	609-0000	81787000 A	1
A4J2	. MALE HEADER 10 PIN	00779	87232-3	81790002	1
	. PULL TAB CONN	17325	3490-1	81793001 B	1
A4R3	. RES. 180 OHM, 1/4W, 5%	01121	RC07GF181T	83015031 B	1
A4R1	. RES. 1K OHM, 1/4W, 5%	01121	RC07GF102T	83015049 E	1
A4R2	. RES. 30K OHM, 1/4W, 5%	01121	RC07GF303T	83015084 E	1
A4PS1	. DC-DC CONVERTER PLUS 5V	27982	50C12-5S1000	84118000	1
A4PS2	. DC-DC CONVERTER 15V	27982	30C12-15D100	84118001 C	1
A4CR9	. DIODE ZENER IN4756	04713	IM47ZS10	84539028 A	1
A4CR1 through CR8	. DIODE 1N4148	15238	1N4148	84830000	8
A4U1	. IC MC1455P1	04713	MC1455P1	84834000	1
	. IC SOCKET 8 PIN	73803	C93-08-10	89075000	1
	. CABLE, RIBBON 16	15912	171-16	89661002	
	PWR SUPPLY ASSY BATT. FOR 7000A-01	99899	212777	212777	1
	. BRACKET, BATT.	99899	212770	212770	1
	. REAR PANEL, BOTTOM	99899	212771	212771	1
	. BOTTOM COVER	99899	212784	212784	1
	. SCR SELF TAP #4-40X 5/16	70318	SCR SELF TAP 4-40 x 5/16	7013500± C	1
	. STANDOFF	06540	8170-A-0632-16	72027002	1
A4E1, E2,E3	. TERM, INSULATED	71279	4838-1-0516	80619000	3
	. BINDING POST	83330	136	80648000	1
	. REC BNC UG-1094/U	91836	UG1094/U	81524000 C	1
A4J1	. PHONE JACK	82389	712A	81592001	1
A4P2	. CONN HOUSING 3 PIN	00779	87499-5	81774006	1
	. CONTACT	00779	86016-2	81775002	2

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A4	. KEY	00779	87077-2	81786001	1
A4R1	. RES 8 OHM 4W	91637	AGS-5-8 OHMS	83265001	1
	. TERMINAL, LUG #2	79963	MS80431-8	87116011	1
A4BT1	. BATTERY	19209	NARDA SCD-88013000	88013000	1
	. WIRE HOOK-UP #20 RED	92914	WIRE HOOK-UP #20 RED	89666002	
	. WIRE STRANDED #20 AWG	92914	WIRE STRANDED #20 AWG	89666007	
	. WIRE HOOK-UP #20 BLK	92914	WIRE HOOK-UP #20 BLK	89666010	
	. WIRE STRANDED #20 AWG	92914	WIRE STRANDED #20 AWG	89666014 A	
	. SOFT SOLDER	92914	SN60 PER QQ-S-571	98503000 A	
	. SOLDER	92914	SOLDER 60/40.015 DIA. SOLID WIRE	98503001	
	. WASHER, FLAT #4	70319	MS5795803	515795803	3
	. FLAT WASHER #6	70318	MS5795805	515795805	1
	. LOCKWASHER, INT. #6	70318	MS5333071	535333071	1
	. LOCKWASHER, INT. 5/16	70318	MS533075	535333075	1
	. LOCKWASHER #4	70318	MS5338135	535338135	3
	. LOCK WASHER #6	70318	MS5338136	535338136	2
	. SCR. PAN HD 4-40 x 1/4 LG	70318	MS1957013	551957013	3
	. SCR. PAN HD 6-32 x 1/4 LG	70318	MS1957026	551957026	1
	. SCR. PH HD. 6-32 x 3/8 LG	70318	MS1957028	551957028	2
	7000A-01 REAR PANEL SUB ASSY, TOP	99899	318913	318913 A	1
	. REAR PANEL, TOP	99899	212779	212779 A	1
	. RIVET TUBULAR 3/32 x 5/32	70318	MS0450290	520450290	2
	SHOULDER STRAP KIT	99899	318943	318943 A	1
	. INSTRUCTION/SHLDR STRP KIT	99899	318944	318944 A	1
	. CLIP	99899	418450	418450 A	2
	. SCR SELF TAP #4-40 x 1/2	70318	SCREW SELF TAP 4-40 x 1/2 PER NARDA, SCD 70135003	70135003 A	2
	. STRAP, SHOULDER, ADJUSTABLE, 1/2" WIDE	99899	99902000	99902000 A	1
	CABLE ASSY 2 1/2 FT. LG.	99899	319067	319067 A	1
	CABLE ASSY 2 1/2 FT. LG.	99899	319067	319067 A	1
	GROMMET	99899	417884	417884 A	1
	SCR SELF TAP #6-32 x 3/8	70318	SCREW SELF TAP #6-32 x 3/8" PER NARDA, 70135002	70135002 C	4

7000A - Option -01

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A4	SPACER #4-40 THD	06540	815A-A-0440-16	72039003	8
	STANDOFF MALE-FEM.	06540	9795-SS-0632-7	72047000 C	2
	PANEL MTG. KIT	00779	552633-4	81809001 A	1
	SCREW LOCK ASSY	15912	609-005	81811000 A	1
	TEST LEAD KIT	83330	610	81813000 A	1
	ADAPTER AC	99899	84047000	84047000 C	1
	WIRE 26 AWG, ORANGE	92914	26 AWG ORANGE	89623008 A	
MP1	SCREW	99899	95630008	95630008 E	4
MP2	HANDLE	99899	9563009	95630009 E	1
MP3	CAP	99899	95630010	95630010 E	2
MP4	BUTTON	99899	95630011	95630011 E	2
MP5	SPRING	99899	95630012	95630012 E	2
MP6	SCREW	99899	95630013	95630013 E	2
MP7	SPACER	99899	95630014	95630014 E	2
MP8	FEET	99899	95630015	95630015 E	4
	TIE, CABLE 0-3/4 DIA	06383	SST-1	98004001 E	2
	WASHER, FLAT #4	70318	MS5795803	515795803	24
	LOCKWASHER #4	70318	MS5338135	535338135	16
	SCR. PAN HD. 2-56 x 3/8 LG.	70318	MS1957005	551957005	2
	SCR. PAN HD. 4-40 x 5/16 LG.	70318	MS1957014	551957014	16

7000A - Option 2

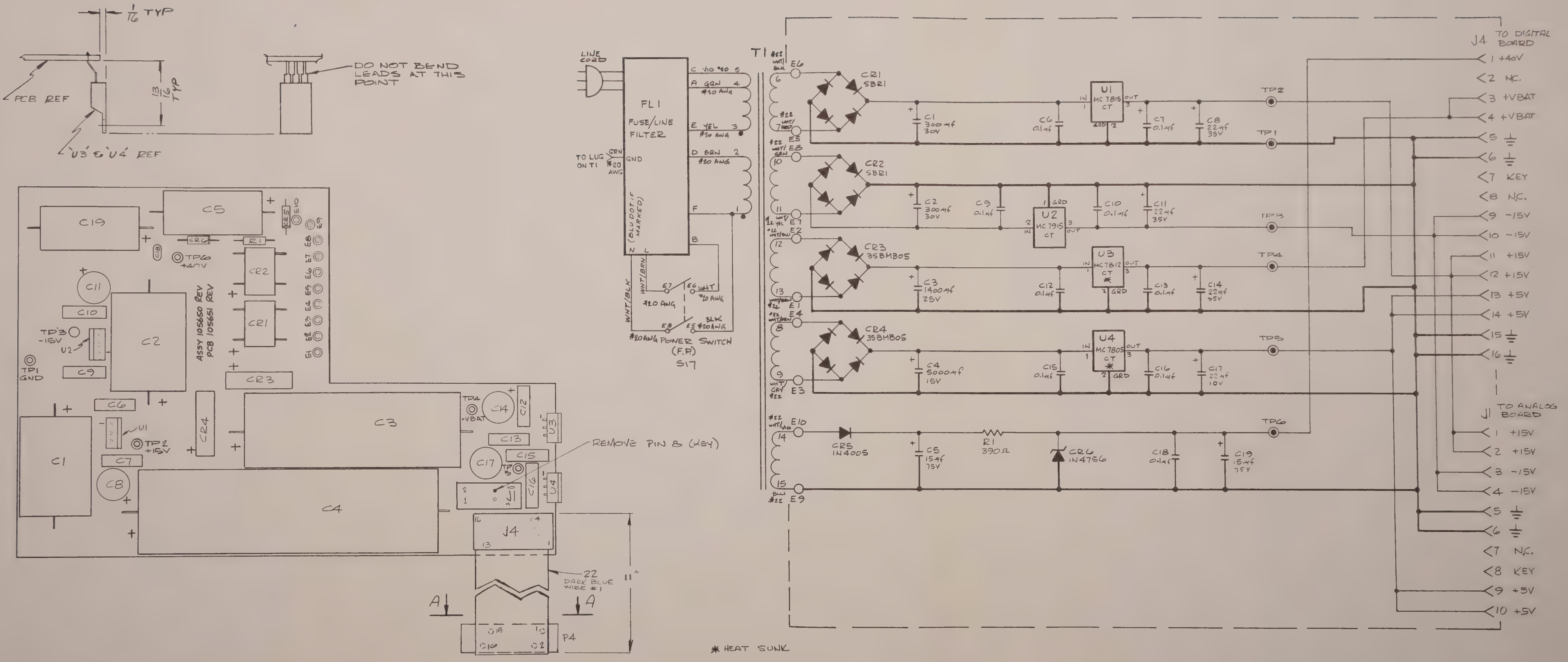
REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A231	SWITCH, ROCKET GRAYHILL	81073	76A06	83723001	1
A2U33	IC SN74LS3667	04713	SN74LS366N	84798366	1
A2U30, U31	IC MC 3447L	04713	MC3447L	84828000	2
A2U32	I.C. MC68488P	04713	MC68488P	84829000	1

SECTION VI

MICROWAVE MULTIMETER SCHEMATICS AND PARTS LOCATION DRAWINGS
NARDA Model 7000A and 7000A-01

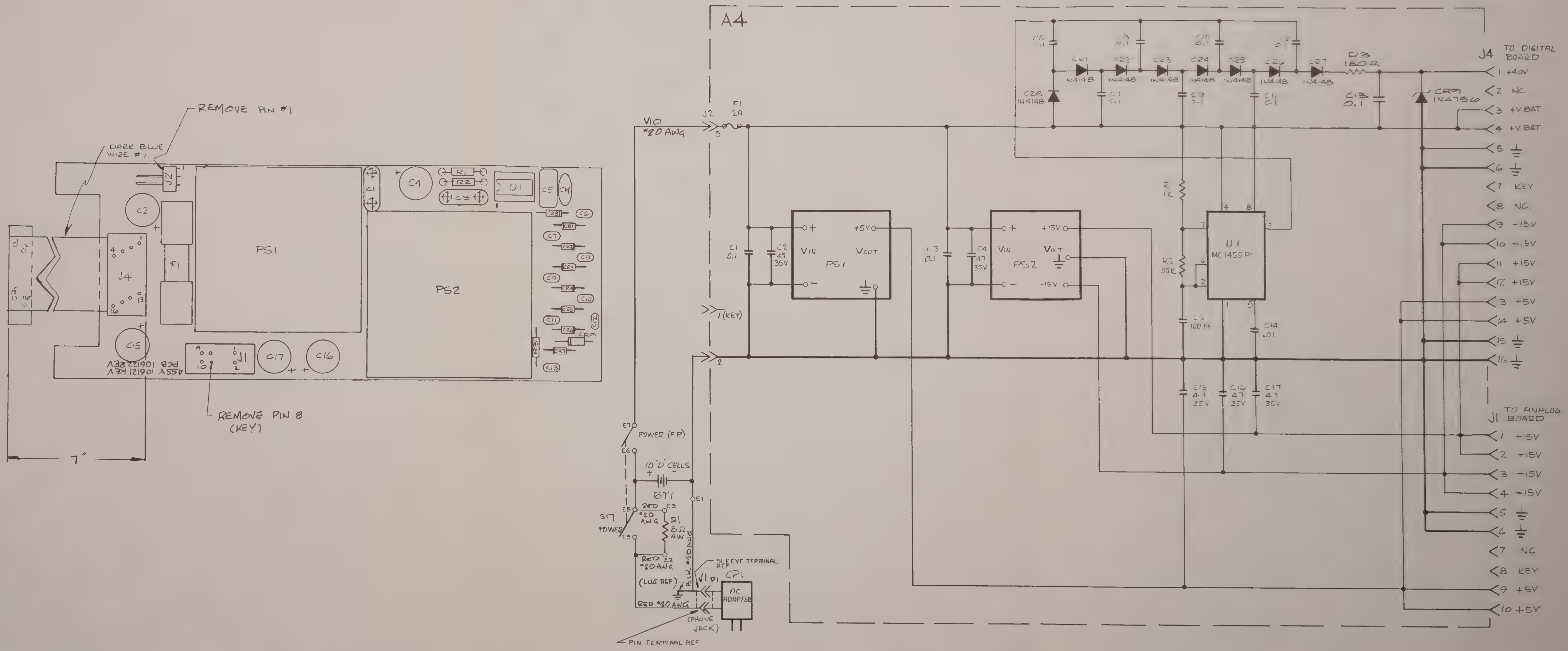
6.1. INTRODUCTION.

This section provides a complete set of schematics, parts location drawings, analog (A3) board wave forms for power meter mode and an exploded view of the multimeter.



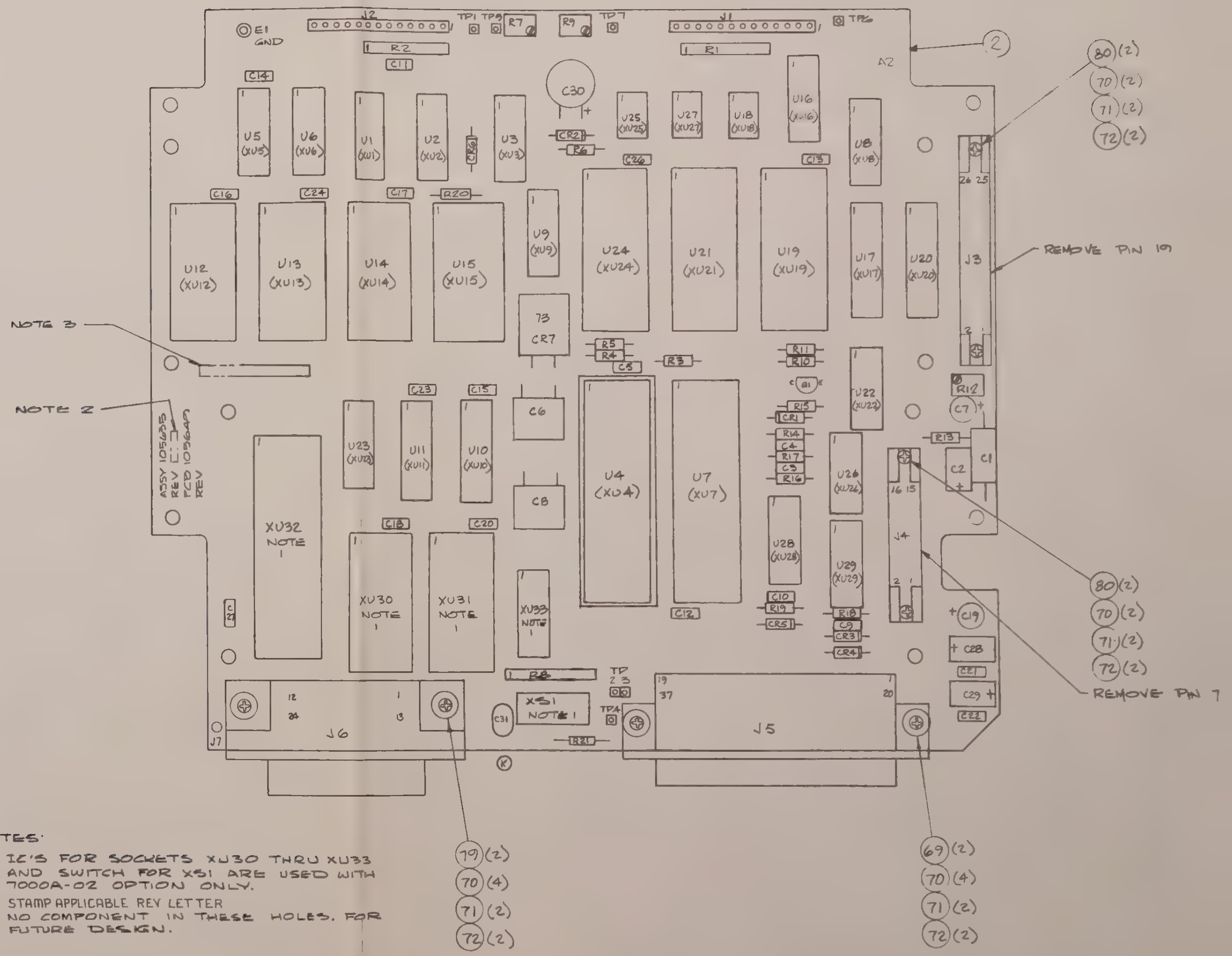
1/16 TYP
PCB REF
13/16 TYP
'U3' & 'U4' REF
DO NOT BEND LEADS AT THIS POINT
C19
C5
CR5
E10
E9
E8
E7
E6
E5
E4
E3
E2
E1
CR6
R1
C18
TP6 +40V
CR2
CR1
C11
C10
TP3 -15V
U2
C2
C9
TP1 GND
ASSY 105650 REV
PCB 105651 REV
CR3
C6
C1
U1
TP2 +15V
C7
C8
CR4
C3
TP4 +VBAT
C14
C12
U3
C13
C15
C17
TP5
C16
U4
J4
C4
REMOVE PIN 8 (KEY)
22 DARK BLUE WIRE #1
11"
A
P4
LINE CORD
TO LUG ON T1
GRN #20 AWG
GND
FL1
FUSE/LINE FILTER
(BLU DOT IF MARKED)
C VIO #20 5
A GRN 4 #20 AWG
E YEL 3 #20 AWG
D BRN 2 #20 AWG
F 1
B
N L
WHT/BLK
WHT/BRN
#20 AWG
E7 E6 WHT #20 AWG
E8 E5 BLK #20 AWG
#20 AWG POWER SWITCH (F.P.) S17
T1
CR1 SBR1
C1 300µf 30V
C6 0.1µf
U1 MC7815 CT
IN OUT GRD
C7 0.1µf
C8 22µf 35V
TP2
TP1
CR2 SBR1
C2 300µf 30V
C9 0.1µf
U2 MC7915 CT
C10 0.1µf
C11 22µf 35V
TP3
CR3 3SBMB05
C3 1400µf 25V
C12 0.1µf
U3 MC7812 CT *
C13 0.1µf
C14 22µf 35V
TP4
CR4 3SBMB05
C4 5000µf 15V
C15 0.1µf
U4 MC7805 CT *
C16 0.1µf
C17 22µf 10V
TP5
CR5 1N4005
C5 15µf 75V
R1 390Ω
CR6 1N4756
C18 0.1µf
C19 15µf 75V
TP6
J4 TO DIGITAL BOARD
1 +40V
2 NC.
3 +VBAT
4 +VBAT
5 ⏚
6 ⏚
7 KEY
8 N.C.
9 -15V
10 -15V
11 +15V
12 +15V
13 +5V
14 +5V
15 ⏚
16 ⏚
J1 TO ANALOG BOARD
1 +15V
2 +15V
3 -15V
4 -15V
5 ⏚
6 ⏚
7 N.C.
8 KEY
9 +5V
10 +5V
* HEAT SUNK

Figure 6-1. Schematic and Parts Location Drawing Power Supply (A4) Board for 7000A


REMOVE PIN #1
DARK BLUE WIRE #1
J2
C2
F1
J4
PS1
PS2
C4
R1
R2
C3
U1
C5
C14
C1
C15
J1
C17
C16
ASSY 106121 REV
PCB 106122 REV
REMOVE PIN 8 (KEY)
7"
A4
V10 #20 AWG
J2
F1 2A
1(KEY)
C1 0.1
C2 47 35V
VIN
VOUT
+5V
C3 0.1
C4 47 35V
+15V
-15V
C6 0.1
C8 0.1
C10 0.1
C12 0.1
CR1
CR2
CR3
CR4
CR5
CR6
CR7
IN4148
CR8 IN4148
C7 0.1
C9 0.1
C11 0.1
R3 180 Ω
C13 0.1
CR9 IN4756
R1 1K
R2 30K
U1 MC1455P1
C5 100 PF
C14 .01
C15 47 35V
C16 47 35V
C17 47 35V
J4 TO DIGITAL BOARD
1 +40V
2 NC.
3 +V BAT
4 +V BAT
5
6
7 KEY
8 NC.
9 -15V
10 -15V
11 +15V
12 +15V
13 +5V
14 +5V
15
16
J1 TO ANALOG BOARD
1 +15V
2 +15V
3 -15V
4 -15V
5
6
7 NC
8 KEY
9 +5V
10 +5V
E7
POWER (F.P.)
E6
10 'D' CELLS
BT1
E1
E8
RED #20 AWG
E3
R1 8Ω 4W
S17 POWER
E5
RED #20 AWG E2
BLK #20 AWG
SLEEVE TERMINAL REF
CP1
J1 P1
(LUG REF)
AC ADAPTER
RED #20 AWG
(PHONE JACK)
PIN TERMINAL REF

NOTES:
1. ALL RESISTORS IN OHMS
2. ALL CAPACITORS IN MFD'S

Figure 6-2. Schematic and Parts Location Drawing Power Supply (A4) Board for 7000A-01

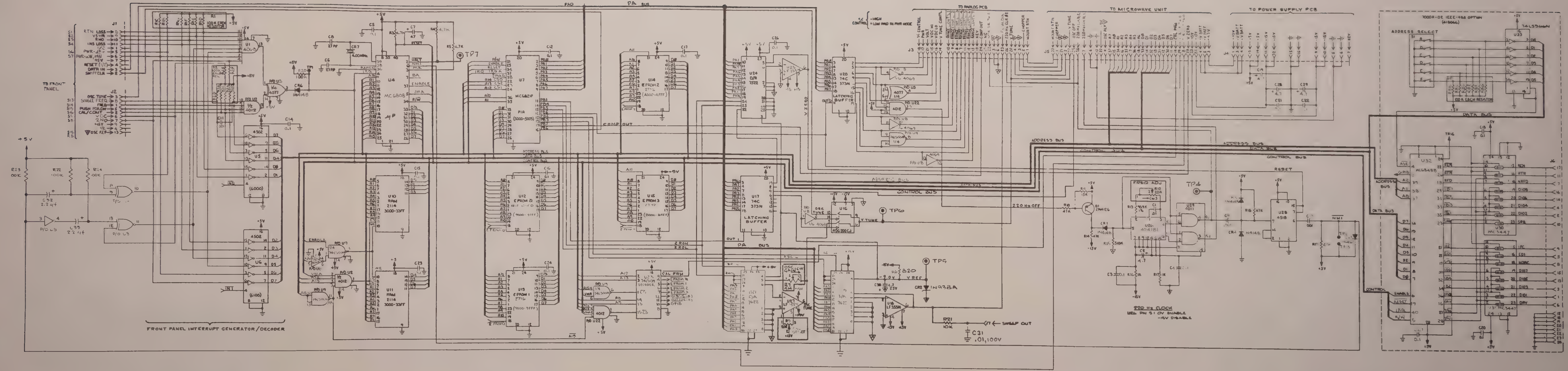

E1 GND
J2
TP1 TP9
R7
R9
TP7
J1
TP6
R2
R1
C11
C14
C30
A2
U5 (XU5)
U6 (XU6)
U1 (XU1)
U2 (XU2)
U3 (XU3)
CR2
R6
U25 (XU25)
U27 (XU27)
U18 (XU18)
U16 (XU16)
U8 (XU8)
C26
C13
C16
C24
C17
R20
U12 (XU12)
U13 (XU13)
U14 (XU14)
U15 (XU15)
U9 (XU9)
U24 (XU24)
U21 (XU21)
U19 (XU19)
U17 (XU17)
U20 (XU20)
J3
26 25
REMOVE PIN 19
NOTE 3
NOTE 2
CR7
R5
R4
C5
R3
R11
R10
Q1
R15
CR1
R14
C4
R17
C3
R16
U22 (XU22)
R12
C7
R13
C1
C2
C23
C15
C6
C8
ASSY 105635 REV
PCB 105640 REV
U23 (XU23)
U11 (XU11)
U10 (XU10)
U4 (XU4)
U7 (XU7)
U26 (XU26)
16 15
J4
XU32 NOTE 1
C18
C20
XU30 NOTE 1
XU31 NOTE 1
XU33 NOTE 1
U28 (XU28)
U29 (XU29)
C10
R19
CR5
R18
C9
CR3
CR4
C12
C27
C19
C28
C21
C29
C22
R8
TP 2 3
XS1 NOTE 1
TP4
R21
C31
J7
J6
J5
2 1
REMOVE PIN 7
(2)
(80)(2)
(70)(2)
(71)(2)
(72)(2)
(79)(2)
(70)(4)
(71)(2)
(72)(2)
(69)(2)
(70)(4)
(71)(2)
(72)(2)

NOTES:

1. IC'S FOR SOCKETS XU30 THRU XU33 AND SWITCH FOR XS1 ARE USED WITH 7000A-02 OPTION ONLY.
2. STAMP APPLICABLE REV LETTER
3. NO COMPONENT IN THESE HOLES. FOR FUTURE DESIGN.

Figure 6-3. Schematic and Parts Location Drawing Digital (A2) Board (Sheet 1 of 3)

NOTE: For 7000A's with serial numbers > 7000.

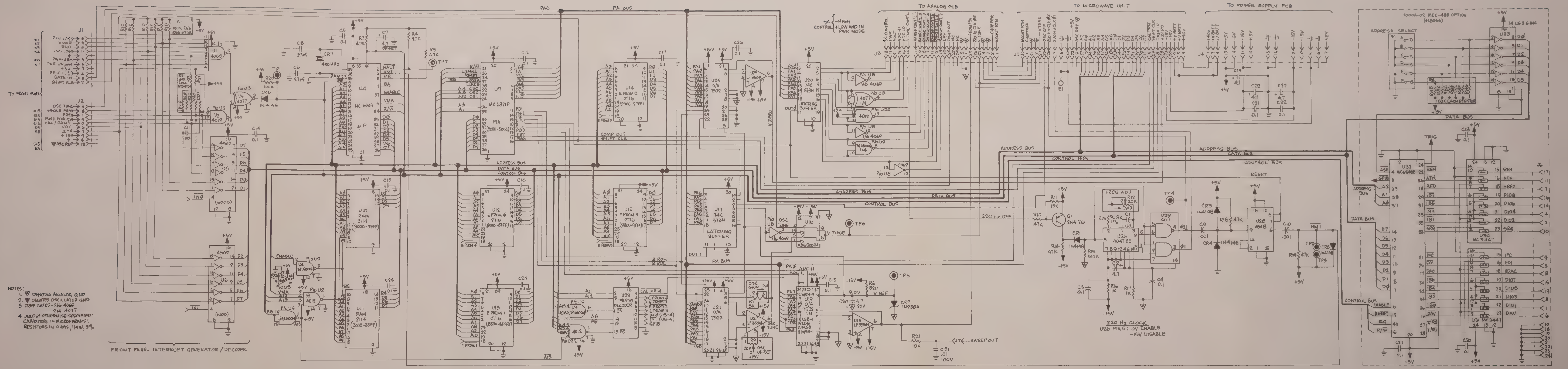

PA BUS
TO FRONT PANEL
RTN LOSS
VSWR
RHO
1-N LOSS
PWR-dB
PWR-mW, mW
RESET (I/C)
DATA IN
SHIFT CLK
OSC TUNE
SINGLE FREQ
FREQ
PUSH FOR DW
CAL/COUNT
+5V
+15V
OSC KEY
MC6808
µP
MC6821P
PIA
RAM 2114
EPROM 2716
74C 373N
LATCHING BUFFER
TP7
TP6
TP5
TP4
IN938A
COMP OUT
ADDRESS BUS
DATA BUS
CONTROL BUS
TO ANALOG PCB
TO MICROWAVE UNIT
TO POWER SUPPLY PCB
7000A-01 IEEE-488 OPTION
ADDRESS SELECT
MC68488
MC3447
220 Hz CLOCK
FREQ ADJ
RESET
SWEEP OUT
C31 .01,100V
FRONT PANEL INTERRUPT GENERATOR/DECODER

NOTES:

1. ▽ DENOTES ANALOG GND
2. ▽ DENOTES OSCILLATOR GND
3. FREE GATES - 2/6 4069
   2/4 4077
4. UNLESS OTHERWISE SPECIFIED CAPACITORS IN MICROFARADS RESISTORS IN OHMS, 1/4W, 5%

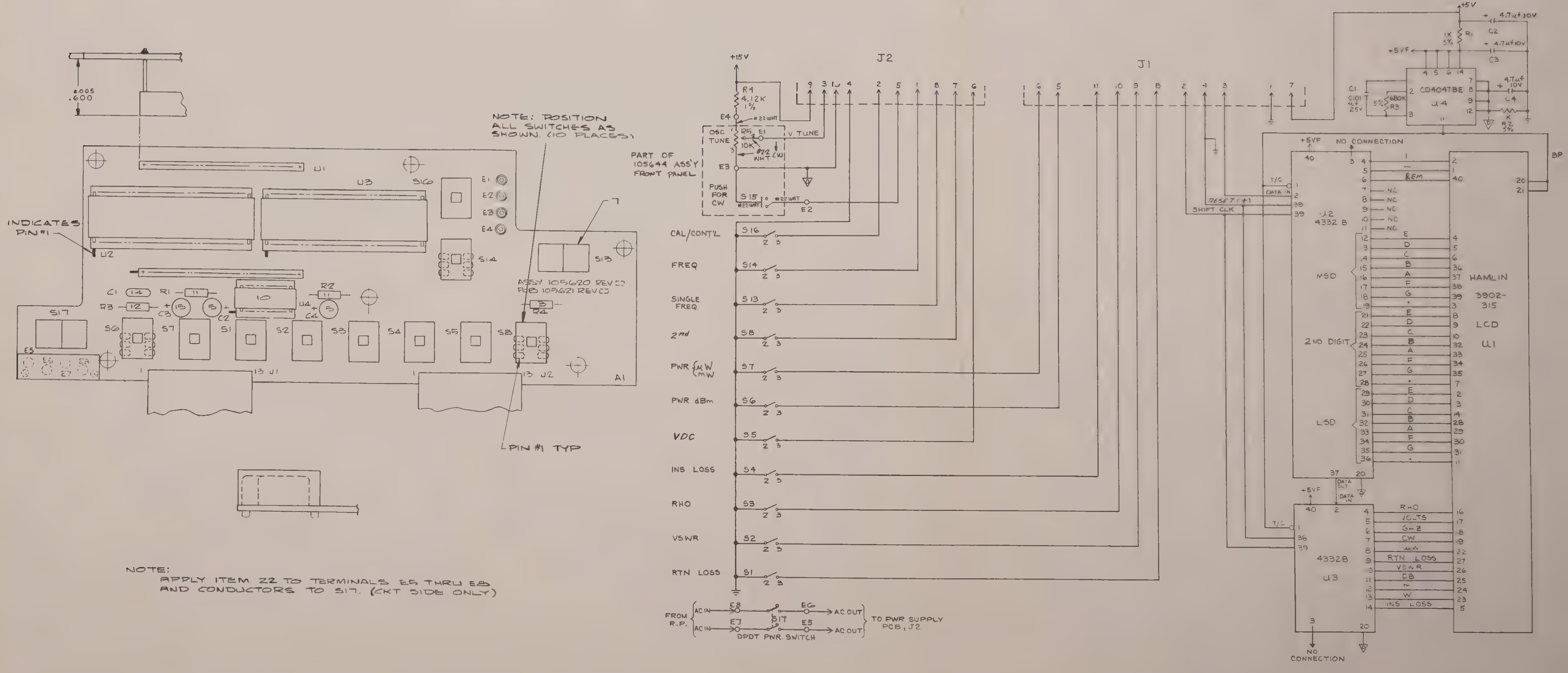
Figure 6-3. Schematic and Parts Location Drawing Digital (A2) Board (Sheet 2 of 3)

NOTE: For 7000A's with serial numbers < 7000.


TO FRONT PANEL
FRONT PANEL INTERRUPT GENERATOR / DECODER
PA BUS
ADDRESS BUS
DATA BUS
CONTROL BUS
TO ANALOG PCB
TO MICROWAVE UNIT
TO POWER SUPPLY PCB
7000A-02 IEEE-488 OPTION (41B044)
ADDRESS SELECT
100K EACH RESISTOR
U4 MC 6808 µP
U7 MC 6821P PIA
U10 RAM 2114
U11 RAM 2114
U12 E PROM 0 2716
U13 E PROM 1 2716
U14 E PROM 2 2716
U15 E PROM 3 2716
U24 D/A 7522
U21 D/A 7522
U19 D/A
U17 74C 373N LATCHING BUFFER
U20 74C 373N LATCHING BUFFER
U23 74LS139 DECODER
U32 MC68488
U28 4518
U26 4047BE
U29 4011
FREQ ADJ
220 Hz CLOCK
U26 PIN 5: 0V ENABLE -15V DISABLE
220 Hz OFF
V TUNE
OSC GAIN CW
OSC OFFSET
SWEEP OUT
V REF
TP1
TP2
TP3
TP4
TP5
TP6
TP7
+HIGH
CONTROL {
+LOW AND IN PWR MODE

NOTES:
1. ▽ DENOTES ANALOG GND
2. ▼ DENOTES OSCILLATOR GND
3. FREE GATES - 2/6 4069
2/4 4077
4. UNLESS OTHERWISE SPECIFIED:
CAPACITORS IN MICROFARADS;
RESISTORS IN OHMS, 1/4W, 5%

Figure 6-3. Schematic and Parts Location Drawing Digital (A2) Board
(Sheet 3 of 3)

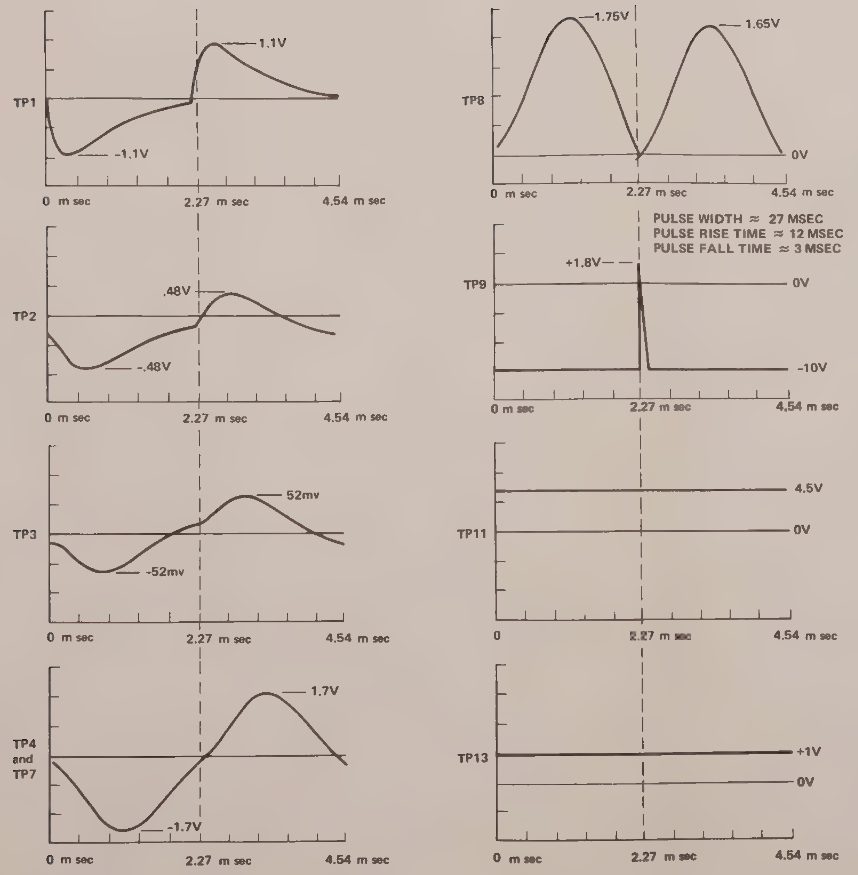

±.005
.600
U1
U3
S16
E1
E2
E3
E4
INDICATES PIN #1
U2
S14
S13
C1
R1
R2
R3
C3
C2
U4
C4
R4
S17
E5
E6
E7
E8
S6
S7
S1
S2
S3
S4
S5
S8
J1
J2
A1
PIN #1 TYP
+15V
R4 4.12K 1%
#22 WHT
OSC TUNE
R5 10K
V TUNE
CW
PART OF 105644 ASS'Y FRONT PANEL
PUSH FOR CW
S15
CAL/CONT'L
FREQ
SINGLE FREQ.
2nd
PWR {μW mW
PWR dBm
VDC
INS LOSS
RHO
VSWR
RTN LOSS
FROM R.P.
AC IN
AC OUT
S17
DPDT PWR. SWITCH
TO PWR SUPPLY PCB, J2
+5V
4.7μf 10V
C2
C3
1K 5%
+5VF
CD4047BE
C1 0.01 μf 25V
680K 5% R3
U4
R2 3%
NO CONNECTION
BP
T/C
DATA IN
RESET
SHIFT CLK
U2 4332 B
MSD
2ND DIGIT
LSD
REM
NC
HAMLIN 3902-315 LCD U1
DATA OUT
4332B U3
RHO
VOLTS
GHZ
CW
RTN LOSS
VSWR
DB
W
INS LOSS
NO CONNECTION

NOTE: POSITION ALL SWITCHES AS SHOWN. (10 PLACES)

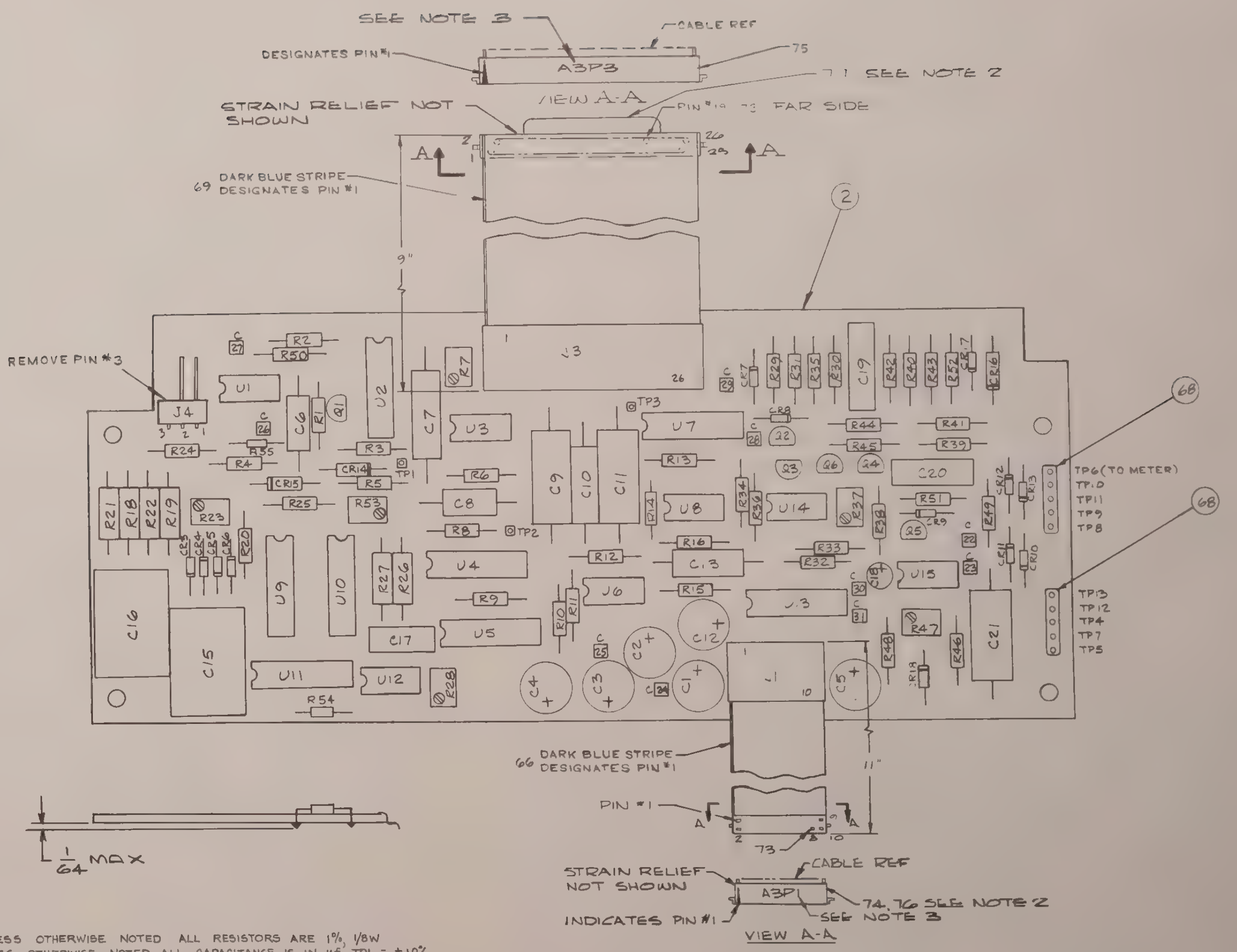
ASSY 105620 REV ☐
PCB 105621 REV ☐

NOTE:
APPLY ITEM 22 TO TERMINALS E5 THRU E8 AND CONDUCTORS TO S17. (CKT SIDE ONLY)

Figure 6-4. Schematic and Parts Location Drawing Front Panel (A1) Board



NOTE: SEE TABLE 4-9 FOR COMPLETE TEST CONDITIONS


SEE NOTE 3
CABLE REF
DESIGNATES PIN #1
A3P3
75
71 SEE NOTE 2
VIEW A-A
STRAIN RELIEF NOT SHOWN
PIN #19 73 FAR SIDE
A
A
69 DARK BLUE STRIPE DESIGNATES PIN #1
9"
2
REMOVE PIN #3
J4
J3
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
C6
C7
C8
C9
C10
C11
C12
C13
C15
C16
C17
C19
C20
C21
R2
R50
R24
R4
R35
R3
R5
R6
R7
R8
R9
R12
R13
R15
R16
R21
R18
R22
R19
R23
R25
R53
R54
R28
R27
R26
TP1
TP2
TP3
TP6 (TO METER)
TP10
TP11
TP9
TP8
TP13
TP12
TP4
TP7
TP5
68
68
66 DARK BLUE STRIPE DESIGNATES PIN #1
11"
PIN #1
73
1/64 MAX
STRAIN RELIEF NOT SHOWN
CABLE REF
A3P1
74, 76 SEE NOTE 2
SEE NOTE 3
INDICATES PIN #1
VIEW A-A

NOTES:

1- UNLESS OTHERWISE NOTED ALL RESISTORS ARE 1%, 1/8W
2- UNLESS OTHERWISE NOTED ALL CAPACITANCE IS IN µf, TOL = ±10%
3- ⏚ - DENOTES REF. GND.

Figure 6-5. Analog (A3) Board Schematic, Parts Location and Waveforms in Power Meter Mode (Sheet 1 of 2)

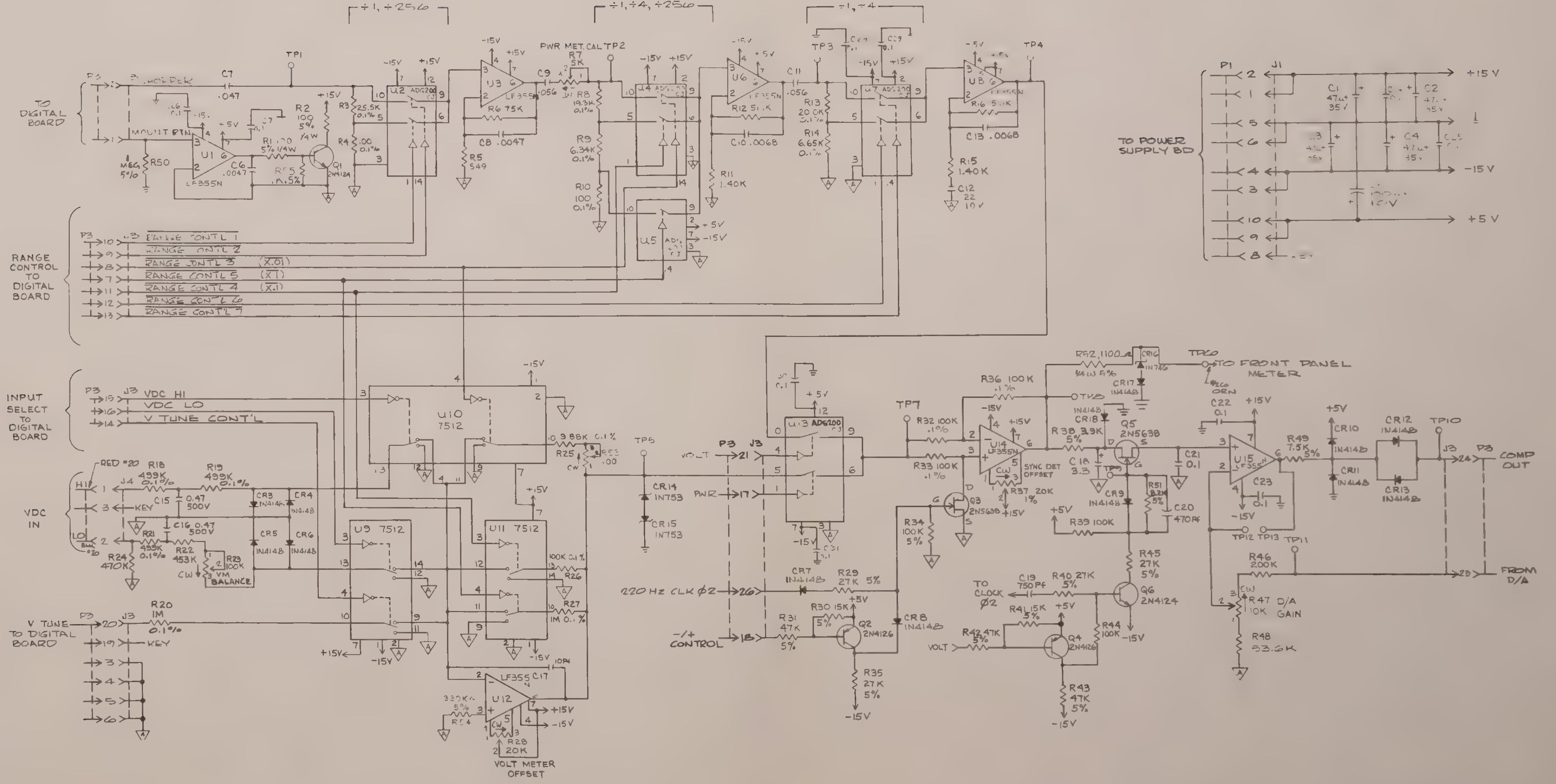

÷1, ÷256
÷1, ÷4, ÷256
÷1, ÷4
TP1
TO DIGITAL BOARD
C7 .047
U1 LF355N
R50
R2 100 5% 1/4W
Q1 2N4124
R3 25.5K 0.1%
R4 100 0.1%
U2 AD7200
U3 LF355N
R6 75K
C8 .0047
R5 549
PWR MET. CAL TP2
R7 5K
C9 .056
R8 19.3K 0.1%
R9 6.34K 0.1%
R10 100 0.1%
U4
U5
U6 LF355N
R12 51.1K
C10 .0068
C11 .056
R11 1.40K
TP3
R13 20.0K
R14 6.65K 0.1%
U7 AD7200
U8 LF355N
C13 .0068
R15 1.40K
C12 22 10V
TP4
P1 J1
TO POWER SUPPLY BD
C1 47µF 35V
C2
C3
C4 47µF 15V
+15 V
-15 V
+5 V
RANGE CONTROL TO DIGITAL BOARD
RANGE CONTL 1
RANGE CONTL 2
RANGE CONTL 3 (X.01)
RANGE CONTL 5 (X1)
RANGE CONTL 4 (X.1)
RANGE CONTL 6
RANGE CONTL 7
INPUT SELECT TO DIGITAL BOARD
VDC HI
VDC LO
V TUNE CONT'L
U10 7512
VDC IN
R18 499K 0.1%
R19 499K 0.1%
C15 0.47 500V
C16 0.47 500V
R21 453K 0.1%
R22 453K
R23 100K VM BALANCE
R24 470K
CR3 1N4148
CR4 1N4148
CR5 1N4148
CR6 1N4148
KEY
U9 7512
U11 7512
R26 100K 0.1%
R27 1M 0.1%
V TUNE TO DIGITAL BOARD
R20 1M 0.1%
U12 LF355
C17 10pf
R28 20K
VOLT METER OFFSET
R25 9.88K 0.1%
TP5
CR14 1N753
CR15 1N753
VOLT
PWR
U13 AD7200
220 Hz CLK Ø2
-/+ CONTROL
CR7 1N4148
R29 27K 5%
R30 15K
R31 47K 5%
Q2 2N4126
R35 27K 5%
CR8 1N4148
TP7
R32 100K .1%
R33 100K .1%
Q3 2N5638
R34 100K 5%
R36 100K .1%
U14 LF355N
R37 20K
SYNC DET OFFSET
R38 3.9K 5%
Q5 2N5638
C18 3.3
CR9 1N4148
R51
C20 470pf
R39 100K
R52 1100
CR16 1N746
CR17 1N4148
CR18 1N4148
TP6 TO FRONT PANEL METER
C21 0.1
TO CLOCK Ø2
C19 750pf
R40 27K 5%
R41 15K 5%
R42 47K 5%
Q4 2N4126
Q6 2N4124
R44 100K
R45 27K 5%
R43 47K 5%
C22 0.1
U15 LF355N
C23 0.1
R49 7.5K 5%
CR10 1N4148
CR11 1N4148
CR12 1N4148
CR13 1N4148
TP10
TP11
TP12
TP13
COMP OUT
R46 200K
R47 10K D/A GAIN
R48 53.6K
FROM D/A

Figure 6-5. Analog (A3) Board Schematic, Parts Location and Waveforms in Power Meter Mode (Sheet 2 of 2)

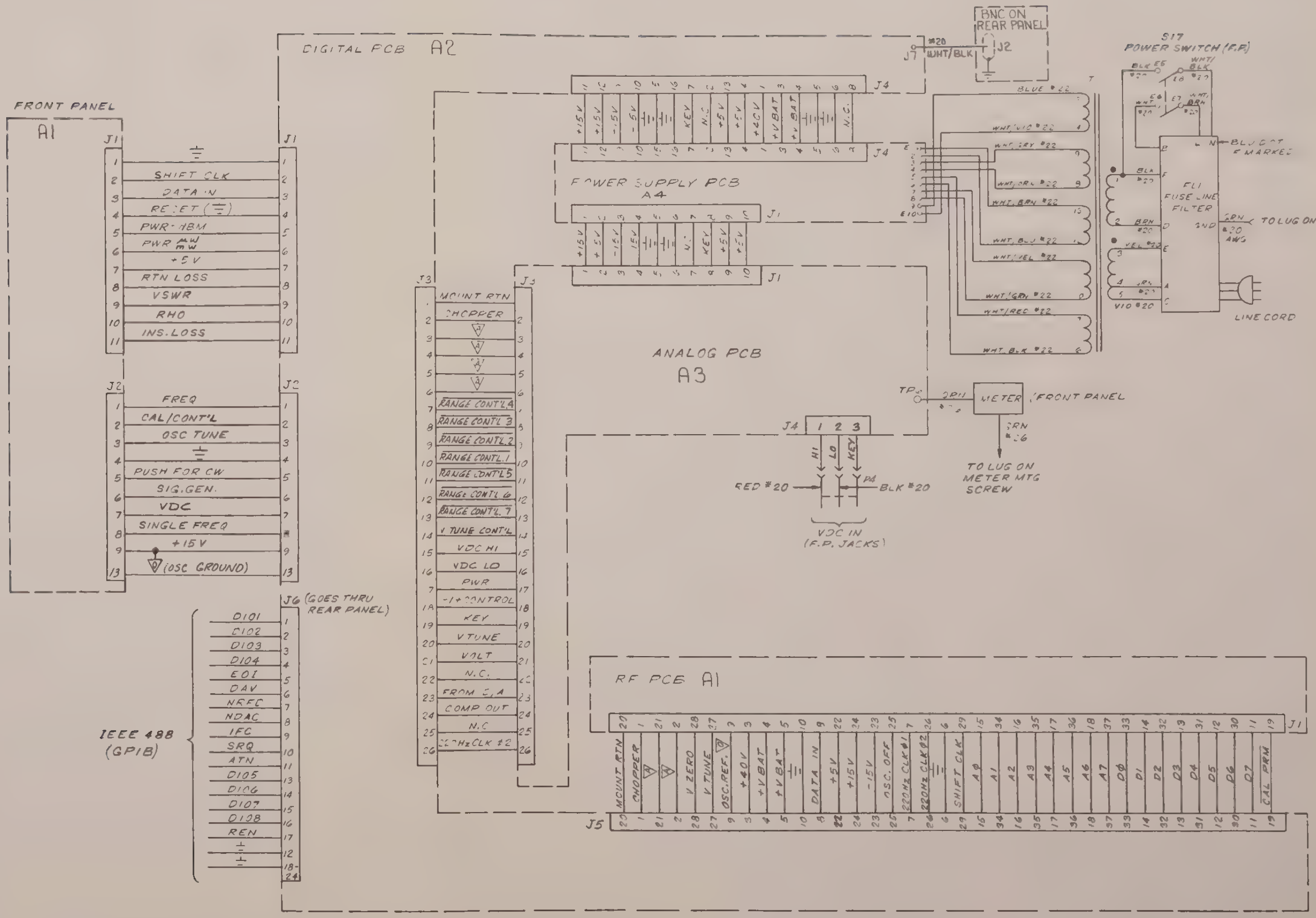

DIGITAL PCB A2
FRONT PANEL A1
J1
SHIFT CLK
DATA IN
RESET
PWR dBM
PWR mW
+5V
RTN LOSS
VSWR
RHO
INS. LOSS
J2
FREQ
CAL/CONT'L
OSC TUNE
PUSH FOR CW
SIG. GEN.
VDC
SINGLE FREQ
+15V
(OSC GROUND)
J6 (GOES THRU REAR PANEL)
IEEE 488 (GPIB)
DIO1
DIO2
DIO3
DIO4
EOI
DAV
NRFD
NDAC
IFC
SRQ
ATN
DIO5
DIO6
DIO7
DIO8
REN
J3
MOUNT RTN
CHOPPER
RANGE CONT'L 4
RANGE CONT'L 3
RANGE CONT'L 2
RANGE CONT'L 1
RANGE CONT'L 5
RANGE CONT'L 6
RANGE CONT'L 7
V TUNE CONT'L
VDC HI
VDC LO
PWR
-/+ CONTROL
KEY
V TUNE
VOLT
N.C.
FROM C/A
COMP OUT
N.C.
220 Hz CLK #2
J4
+15V
-15V
+5V
KEY
N.C.
+40V
+V BAT
POWER SUPPLY PCB A4
BNC ON REAR PANEL
J7
#20 WHT/BLK
J2
S17 POWER SWITCH (F.P.)
T
BLUE #22
WHT/VIO #22
WHT/GRY #22
WHT/ORN #22
WHT/BRN #22
WHT/BLU #22
WHT/YEL #22
WHT/GRN #22
WHT/RED #22
WHT/BLK #22
BLK #20
BRN #20
YEL #22
ORN #20
VIO #20
FL1 FUSE LINE FILTER
GND
BLU DOT MARKED
GRN #20 AWG
TO LUG ON T1
LINE CORD
ANALOG PCB A3
TP
METER (FRONT PANEL)
GRN #26
TO LUG ON METER MTG SCREW
J4 1 2 3
HI
LO
KEY
P4
RED #20
BLK #20
VDC IN (F.P. JACKS)
RF PCB A1
J1
J5
MOUNT RTN
CHOPPER
V ZERO
V TUNE
OSC. REF.
+40V
+V BAT
+V BAT
DATA IN
+5V
+15V
-15V
OSC. OFF
220 Hz CLK #1
220 Hz CLK #2
SHIFT CLK
A0
A1
A2
A3
A4
A5
A6
A7
D0
D1
D2
D3
D4
D5
D6
D7
CAL PRM

Figure 6-6. Interconnection Diagram for 7000A

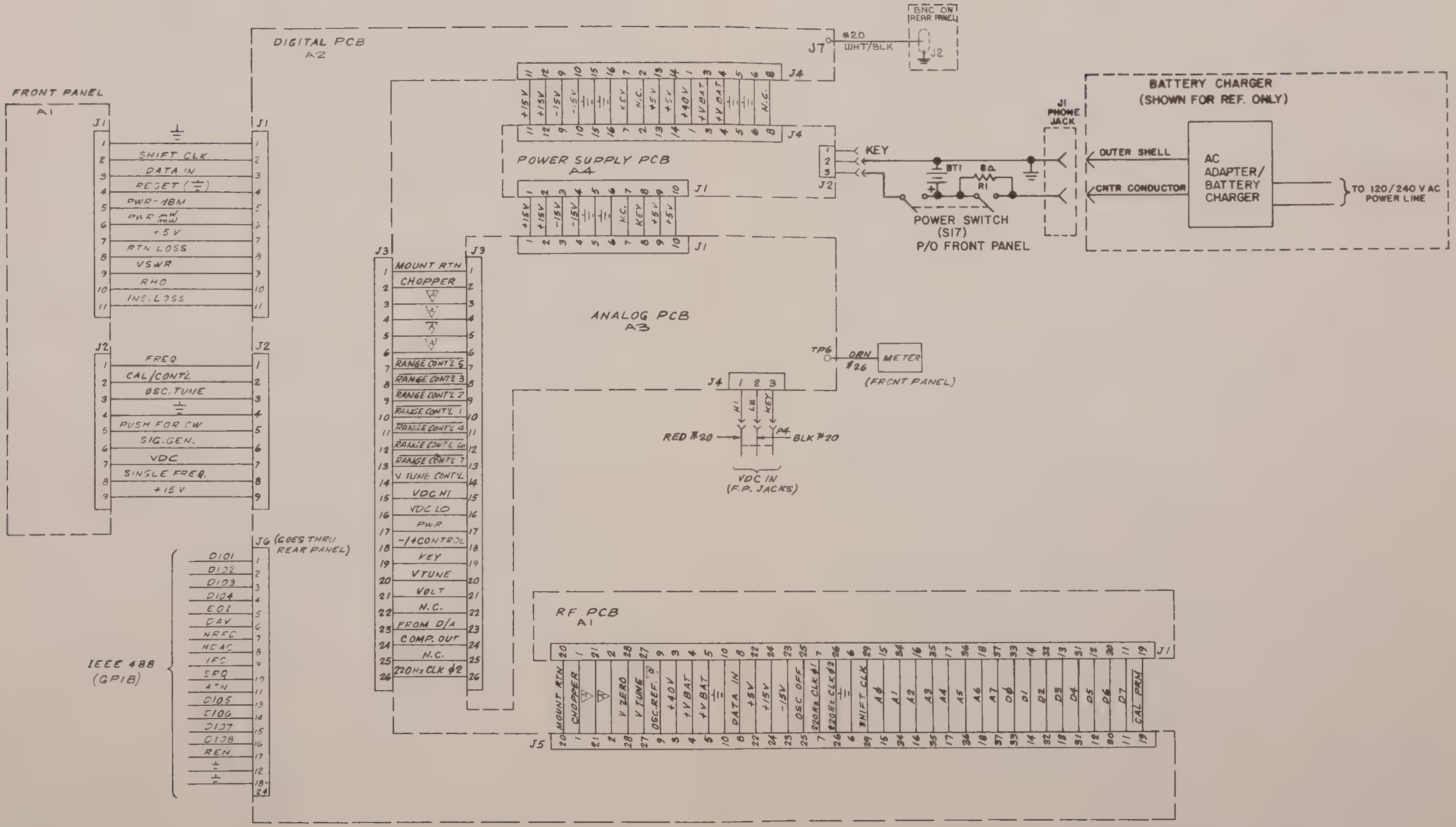

DIGITAL PCB
A2
FRONT PANEL
A1
J1
SHIFT CLK
DATA IN
RESET
PWR-dBM
PWR mW
+5V
RTN LOSS
VSWR
RHO
INS. LOSS
J2
FREQ
CAL/CONT'L
OSC. TUNE
PUSH FOR CW
SIG. GEN.
VDC
SINGLE FREQ.
+15V
J6 (GOES THRU REAR PANEL)
IEEE 488
(GPIB)
DIO1
DIO2
DIO3
DIO4
EOI
DAV
NRFD
NDAC
IFC
SRQ
ATN
DIO5
DIO6
DIO7
DIO8
REN
J7
#20
WHT/BLK
BNC ON REAR PANEL
J2
J4
+15V
+15V
-15V
-15V
KEY
N.C.
+5V
+5V
+40V
+V BAT
+V BAT
N.C.
POWER SUPPLY PCB
A4
J1
KEY
J2
KEY
BT1
8Ω
R1
POWER SWITCH
(S17)
P/O FRONT PANEL
J1
PHONE
JACK
BATTERY CHARGER
(SHOWN FOR REF. ONLY)
OUTER SHELL
CNTR CONDUCTOR
AC
ADAPTER/
BATTERY
CHARGER
TO 120/240 V AC
POWER LINE
J3
MOUNT RTN
CHOPPER
RANGE CONT'L 5
RANGE CONT'L 3
RANGE CONT'L 2
RANGE CONT'L 1
RANGE CONT'L 4
RANGE CONT'L 6
RANGE CONT'L 7
V TUNE CONT'L
VDC HI
VDC LO
PWR
-/+CONTROL
KEY
V TUNE
VOLT
N.C.
FROM D/A
COMP. OUT
N.C.
220Hz CLK φ2
ANALOG PCB
A3
TP6
ORN
#26
METER
(FRONT PANEL)
J4
1 2 3
HI
LO
KEY
P4
RED #20
BLK #20
VDC IN
(F.P. JACKS)
RF PCB
A1
J1
MOUNT RTN
CHOPPER
V ZERO
V TUNE
OSC.REF.
+40V
+V BAT
+V BAT
DATA IN
+5V
+15V
-15V
OSC OFF
220Hz CLK φ1
220Hz CLK φ2
SHIFT CLK
A0
A1
A2
A3
A4
A5
A6
A7
D0
D1
D2
D3
D4
D5
D6
D7
CAL PRM
J5

Figure 6-7. Interconnection Diagram for 7000A-01

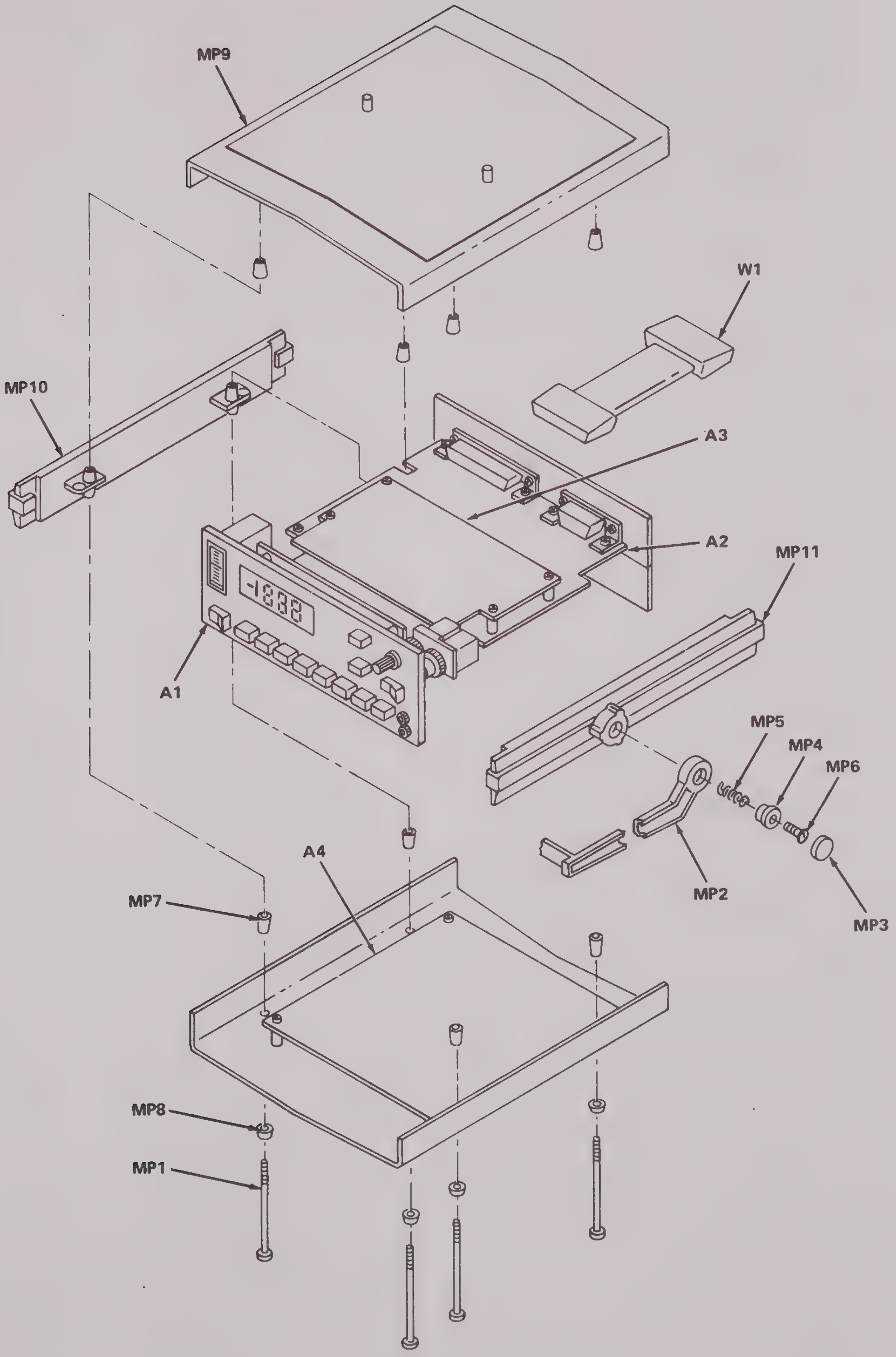

MP9
W1
MP10
A3
A2
MP11
A1
MP5
MP4
MP6
A4
MP2
MP7
MP3
MP8
MP1

Figure 6-8. Multimeter Exploded View

ADDENDUM SHEET FOR MODEL 7134-S1

I. General:

The Model 7134-S1 is a Model 7134 with RF Source (Oscillator and matching Isolator) and Attenucoupler modified to operate over the 4.0 to 5.0 GHz band. Additionally, the low pass filter has been changed.

II. Specifications — Section I

A) Frequency Range: 4.0 to 5.0 GHz
All parts of the standard Model 7134 Manual which reference the 4.0 to 4.5 GHz band should be changed to read 4.0 to 5.0 GHz.

B) Frequency Stability, 0 to 50°: ±1.0%

C) All other specifications are the same as those for the standard Model 7134.

III. Replaceable Parts List — Section V

REF. DESIG.	1234567 DESCRIPTION	MFG. CODE IDENT	MFG. PART NO.	NARDA PART NO.	QTY.
A3	RF Source (Oscillator & matching Isolator & Calibration PROM)	99899	21369401	21369401	1
FL1	Low Pass Filter	99899	86979011	86979011	1
A4	Attenucoupler	99899	10631611	10631611	1

All other parts are the same as those for the standard Model 7134.

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Table 1-10

Optional Accessories for Model 7134

Item	Description	Model Number
Termination	Type N male	379 BNM
Termination	Type N female	379 BNF
Termination	7 mm	5379
Attenuators	Type N 3 dB	777C-3
	6 dB	777C-6
	10 dB	777C-10
	20 dB	777C-20
	30 dB	777C-30
	NOTE 1,2,4,5,7,8,9,40,50 and 60 dB attenuators are also available.	
Detector	Type N	503
Adapters	7 mm to Type N	
	N female to 7 mm	5066
	N male to 7 mm	5067
Adapters	SMA to Type N	
	SMA female to N male	55
	SMA male to N male	56
	SMA male to N female	57
	SMA female to N female	58
Adapters	Type N	
	N male to N male	76
	N female to N female	77

PROM also contains all the data required for the 7000A to compute the calibration factor of the detector. The sensing element is a zero bias schottky diode. Digital linearization eliminates the drift associated with conventional segmentation circuits.

1.3. SPECIFICATIONS.

See Tables 1-1 through 1-5 for Microwave Unit specifications, and Figures 1-2 and 1-3 for physical dimensions of the Microwave Unit and detector. Unless otherwise stated, parameters called out in Table 1-1 through 1-4 are stated at 23°C. It should also be noted that all microwave unit power requirements are supplied by the 7000A. All specifications given are for a complete microwave multimeter system, consisting of a Model 7134 Microwave Unit and a Model 7000A Microwave Multimeter.

Table 1-1

Power Meter Specifications

Specification	Description
FREQUENCY:	0.01 to 18 GHz
POWER LEVEL:	-50 to +13 dBm 10 nW to 20 mW
POWER SENSOR TYPE:	Zero Bias Schottky
SENSOR VSWR:	≤ 1.50:1, .01 to .05 GHz ≤ 1.20:1, .05 to 4.0 GHz ≤ 1.4:1 4 to 18 GHz
MAXIMUM POWER:	200mW C.W. Average for 1 minute 1 Watt Peak 20 Volts AC + DC
ACCURACY:	±3% (0.15 db) For Instrument ± Measurement Uncertainty*

*Measurement Uncertainty = Mismatch Uncertainty ± Calibration Factor Uncertainty

Table 1-1 (Cont)

Specification	Description
ZERO:	Set automatically during calibration. The residual zero error is eliminated on every range.
CALIBRATION FACTOR:	
GENERAL	Calibration factor is stored in a calibration PROM. Frequency of the measurement is entered with the "Tune" control on the 7000A front panel. The 7000A then automatically corrects the measured power.
FREQUENCIES	The calibration PROM contains calibration factors for 50 MHz and at every 1.024 GHz increment, starting at 1.024 GHz (19 total).
UNCERTAINTY	The calibration factor uncertainties are given below:

Frequency	Worst Case Uncertainty (%)	% Probable Uncertainty (RSS)
2.048	6.3	2.7
4.096	6.9	3.0
6.144	6.7	2.9
8.192	6.9	3.0
10.240	6.7	2.9
12.288	8.8	4.1
14.336	10.4	4.7
16.384	10.3	4.6
18.000	10.2	4.6

Table 1-2

Insertion Loss and Gain Measurement Specifications

Specification	Description
MEASUREMENT RANGE:	0 to 50 dB for insertion loss 0 to 63 dB for gain with optional attenuators
FREQUENCY RANGE:	4.0 - 4.5 GHz
TEST PORT SIGNAL LEVEL:	0 dBm minimum +5 dBm maximum
TEST PORT VSWR:	1.10:1
POWER LEVEL VARIATION (AT TEST PORT):	± 2.0 dB
FREQUENCY ACCURACY:	±0.5% at 23°C
FREQUENCY STABILITY:	±0.5% : 0° to 50°C
AUTO-RANGING:	Instrument automatically selects optimum range.
AUTO-ZEROING:	Instrument zeros itself before each measurement.
SELF-CALIBRATING:	Calibration instructions are given to the operator when a calibration is required.
MEASUREMENT POINTS:	SINGLE FREQ: Repetitively makes measurements at one point. Continuously adjustable with "TUNE" control. AUTO STEP: 12 or 52: 11 or 51 equally spaced fixed points plus variable single frequency point.*
ACCURACY:	±3% (± .15dB) ± Mismatch Uncertainty.

*Operator-selectable End Points

Table 1-2 (Cont)

Specification	Description
INSTRUMENT DISPLAY MODES:	Three Operator-Selectable Display Modes: 1. Display minimum and maximum data only. 2. Display data at each point and then continue to next point. 3. Display data at each point and wait for operator control before continuing.

Table 1-3

Reflection Measurement Specifications

Specification	Description
DISPLAY MODES:	RETURN LOSS VSWR RHO
MEASUREMENT RANGE:	Return Loss: 0 to 35 dB VSWR: 1.04 to 2.00 RHO: .018 to .99
FREQUENCY RANGE:	[illegible].0 to [illegible].5 GHz
TEST PORT VSWR:	1.15:1
DIRECTIVITY:	40 dB
TEST PORT SIGNAL:	0 dBm Minimum +5 dBm Maximum
POWER LEVEL VARIATION:	± 2.0 dB
FREQUENCY ACCURACY:	±0.5%
AUTO-RANGING:	Instrument automatically selects optimum range.
AUTO-ZEROING:	Instrument zeros itself before each measurement.
SELF-CALIBRATING:	Calibration instructions are given to the operator when a calibration is required.
MEASUREMENT POINTS:	SINGLE FREQ: Repetitively makes measurements at one point. Continuously adjustable with "TUNE" control. AUTO STEP: 12 or 52 points: 11 or 51 equally spaced points plus variable single frequency point.*

*Operator-selectable End Points

Table 1-3 (Cont)

Specification	Description
ACCURACY:	± 3% (± .15 dB) ± Mismatch Uncertainty ± Directivity Uncertainty
INSTRUMENT DISPLAY MODES:	Three operator-selectable Display Modes: 1. Display minimum and maximum data only. 2. Display data at each point and then continue to next point. 3. Display data at each point and wait for operator control before continuing.

Table 1-4

Signal Generator Specifications

Specification	Value
Frequency Range	4.0 to 4.5 GHz
Test Port Signal Level	0 dBm minimum +5 dBm maximum
Signal Level Variation	± 2.0 dB
Frequency Accuracy	±0.5% At 23°C
Frequency Stability	±0.5%, 0 to 50°C
Harmonic Level	≤ -40 dBc
Spurious Signals	≤ -55 dBc
Residual FM	± 200 KHz

Table 1-5

Environmental Specifications

Specification	Description
Temperature	Operating: 0 to 50°C Non-Operating: -40 to +60°C
Humidity	0% to 95% relative humidity (non-condensing).
Altitude	Operating: 0 - 15,000 Ft. Non-Operating: 0 - 25,000 Ft.

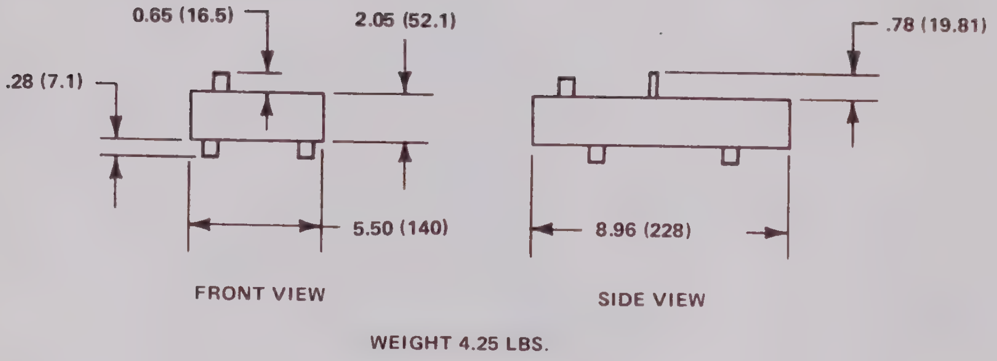

0.65 (16.5)
2.05 (52.1)
.78 (19.81)
.28 (7.1)
5.50 (140)
8.96 (228)
FRONT VIEW
SIDE VIEW
WEIGHT 4.25 LBS.

Figure 1-2. Microwave Unit Case Dimensions

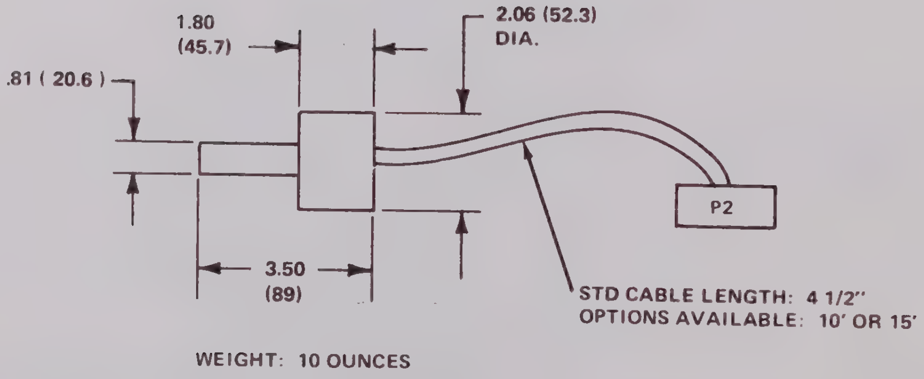

1.80
(45.7)
2.06 (52.3)
DIA.
.81 (20.6)
P2
3.50
(89)
STD CABLE LENGTH: 4 1/2"
OPTIONS AVAILABLE: 10' OR 15'
WEIGHT: 10 OUNCES

Figure 1-3. Detector Physical Dimensions

1-4. ACCESSORIES SUPPLIED.

Table 1-6 lists the accessories supplied with the Model 7134 Microwave Unit.

Table 1-6

Accessories Supplied with Model 7134

Item	Description	Model Number
1	Termination	379 BNM
2	Short/Open 7 mm	5231
3	Short open Type N	231-416
4	7 mm to Type N Female	5067

1.5. OPTIONS.

This section contains tables of connector options, accessory kits, adapter conversion kits and accessory options for the Model 7134. In addition to these tabled options Narda offers a rack mounting storage drawer as a convenient storage place for microwave units. It is Narda part number 106282. Table 1-7 lists the connector options for the Test Port and Power Sensor along with the accessories supplied with each option. Table 1-8 lists the adapter conversion kits available and their use. Table 1-9 lists the components in the adapter conversion kits and Table 1-10 lists the optional accessories for the Model 7134.

Table 1-7

Connector Options

Connectors			Standard Accessories					Option
Test Port	Coupled Port	Power Sensor	Load	Adapters Descritpion	Adapter Model No.	Short/Open Description	Short/Open Model No.	Number
7 mm	N female	7 mm	379BNM	7 mm-N male	5066	7 mm	5231	-21
N female	N female	N male	379BNM	N male/male	76	N female & N male	231-412 & 231-416	-22*

NOTE

Model 7103 is supplied as standard with the following connectors:

Test Port (J1)	7 mm
Coupled Port (J2)	Type N female
Power Sensor	Type N male

*Directivity specification for option -22 is 37 dB

Table 1-8

Adapter Conversion Kits

Conn. Options	If the RF Head Connectors Are:			And you wish to perform measurements using:	Select Accessory Kit No.: (See Table 1-9)
	Test Port	Detector Port	Power Sensor		
Std	7 mm	N female	N male	Type N	1
Std	7 mm	N female	N male	SMA	2
-21	7 mm	N female	7 mm	Type N	3
-21	7 mm	N female	7 mm	SMA	4
-22	N female	N female	N male	SMA	5
-22	N female	N female	N male	7 mm	6
-22	N female	N female	N male	Type N	7

Table 1-9

Accessory Kits

Kit No. (Ref. Table 1-8)	Connector Type	Adapters	Short/ Opens	No. Items
1	"N"	7 mm-N male, N female-N female	N female	3
2	SMA	7 mm-SMA female, 7 mm-SMA male, N female-SMA female, N-female-SMA male	SMA Male SMA female	6
3	"N"	7 mm-N female (2), 7 mm-N male	N male N female	5
4	SMA	7 mm-SMA male (2) 7 mm-SMA female (2)	SMA male SMA female	6
5	SMA	N male-SMA female, N male-SMA male, N female-SMA male, N female-SMA female	SMA male SMA female	6
6	7 mm	7 mm-N male, 7 mm-N female	7 mm	3
7	"N"	N male-N male	-	1

Table 1-10

Optional Accessories for Model 7134

Item	Description	Model Number
Termination	Type N male	379 BNM
Termination	Type N female	379 BNF
Termination	7 mm	5379
Attenuators	Type N 3 dB	777C-3
	6 dB	777C-6
	10 dB	777C-10
	20 dB	777C-20
	30 dB	777C-30
	NOTE 1,2,4,5,7,8,9,40,50 and 60 dB attenuators are also available.	
Detector	Type N	503
Adapters	7 mm to Type N	
	N female to 7 mm	5066
	N male to 7 mm	5067
Adapters	SMA to Type N	
	SMA female to N male	55
	SMA male to N male	56
	SMA male to N female	57
	SMA female to N female	58
Adapters	Type N	
	N male to N male	76
	N female to N female	77

1.6. UNPACKING AND RESHIPMENT.

The following instructions should be carefully observed to avoid damage to the Microwave Unit caused by transportation and handling.

1.6.1. Unpacking. Unpacking of the Microwave Unit should be done with extreme care. The equipment is normally shipped in a double cardboard carton and lined with foam filler material for protection. Before opening, visually inspect the carton to ensure that no damage has occurred during transit. If damaged, notify the shipping agent immediately. If there is no evidence of damage, carefully unpack and remove the equipment.

NOTE

It is suggested that the shipping container and packing material be stored for possible reshipment of the unit.

1.6.2. Reshipment. When reshipping the unit, use the original packing material and shipping container or a good commercial grade high density filler material approximately four inches (10 cm) thick and double high-burst cardboard carton.

1.6.3 Packing. When packing the unit for reshipment, proceed as follows:

1.6.3.1. Cover the bottom of the carton with filler material;

1.6.3.2. Place the unit into the carton;

1.6.3.3. Place filler material on all sides and top of the unit;

1.6.3.4. Place sufficient material around all units being returned.

1.6.3.5 Thoroughly seal the carton.

SECTION II
MICROWAVE UNIT OPERATION
NARDA Model 7134

2.1. INTRODUCTION.

This section contains initial inspection, preparation for use and storage drawer option assembly instructions. Front and rear panel features are discussed. Refer to Section II; Operation, of the 7000A Microwave Multimeter Operation and Maintenance Manual for all power requirements, line voltage selection, turn-on and operation procedures.

2.2. INITIAL INSPECTION.

The Model 7134 was tested and inspected at the factory before shipment. Initially inspect the unit according to instructions in Section I paragraph 1.6.1 of this manual. If any equipment is damaged, notify the Narda Microwave Corporation and the carrier, immediately.

2.3. PREPARATION FOR USE.

Before connecting the Model 7000A to any power source, connect the 37 conductor cable assembly (Narda part number 319067) between "TO MICROWAVE UNIT," located on the rear panel of the multimeter and the 37 pin receptacle marked "TO MODEL 7000A," located on the rear panel of the microwave unit. Consult the Multimeter maintenance and operation manual for power requirements and line voltage selection. Use the Model 7134 Microwave Unit only with a multimeter that has been connected to its power source in accordance with the following **WARNING** notices, as appropriate:

WARNING

(If using the Model 7000A multimeter). Do not bypass the protective third wire ground when connecting the instrument to a power source, because this will defeat the safety feature.

WARNING

(If using the Model 7000A-01.) Connect the chassis ground, located on the rear panel of the multimeter, to a good earth ground to prevent electrical shock.

2.4. RACK MOUNTED STORAGE DRAWER.

To assemble rack mounted storage drawer, Narda part number 106282, proceed as follows:

2.4.1. Attach slides to drawers.

2.4.2. Using the Rack Mounted Storage Drawer. Microwave units are attached to the standoffs, using existing spring loaded screws located on the microwave unit. The power sensor assembly should be mounted to the front of the microwave unit by using the J1 connector, to prevent damage.

2.5. PANEL FEATURES.

The front and rear panel features of Model 7134 shown in Figures 2-1 and 2-2 are described in Tables 2-1 and 2-2.

2.6. INTERCONNECT AND TURN-ON PROCEDURE.

If using Model 7000A refer to the block diagram in Figure 2-3. If using Model 7000A-01 refer to the block diagram in Figure 2-4. Select line voltage, power source and conduct preoperational checkout as directed in the microwave multimeter manual for the 7000A.

CAUTION

Do not use excessive force when mating connectors on the microwave unit. Cross threading, overtorquing or other damage to connectors may degrade system accuracy.

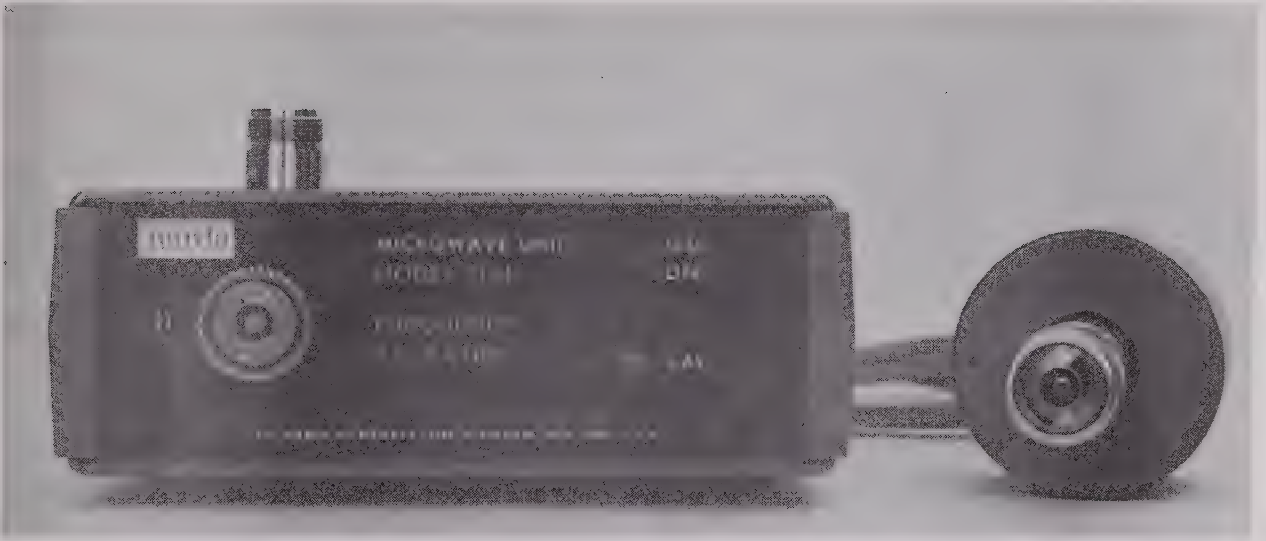

MICROWAVE UNIT
ON

Figure 2-1. Model 7134 Front Panel

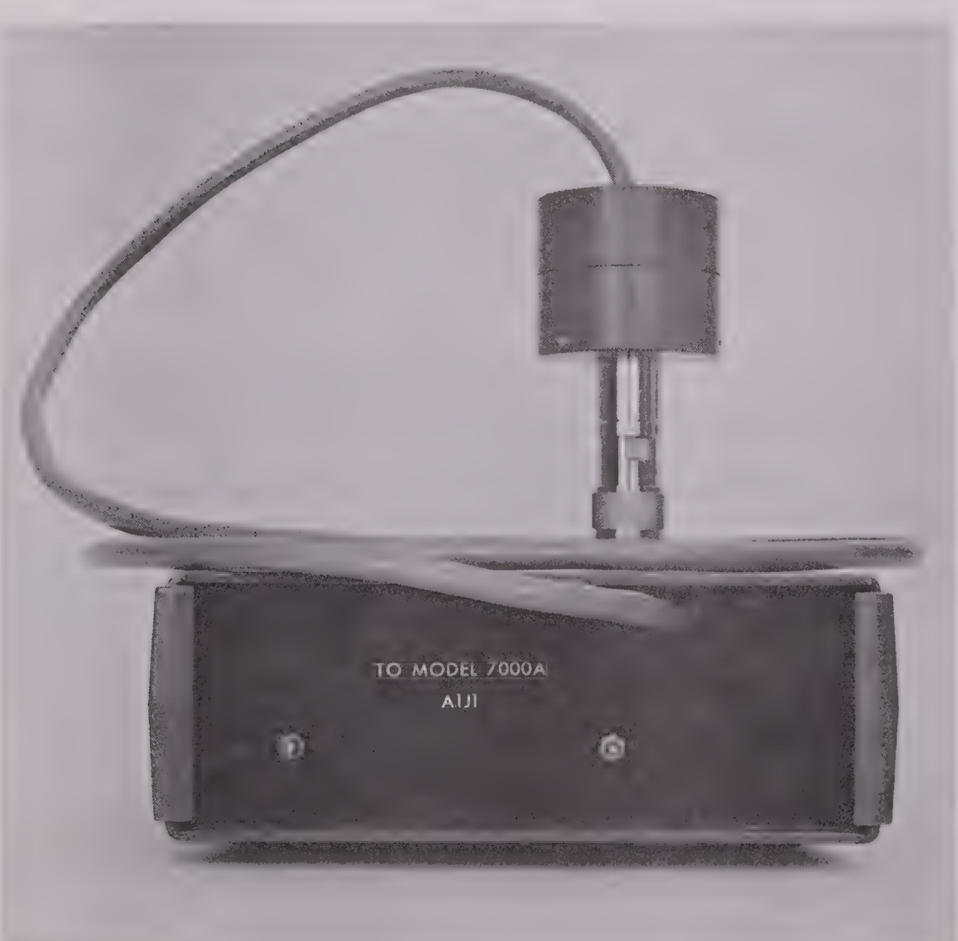

TO MODEL 7000A
A1J1

Figure 2-2. Model 7134 Rear Panel

Table 2-1

Front Panel Operating Controls, Indicators and Connectors

Figure 2.1 Index No.	Control/ Connector	Function
1	J1	Test port for Insertion Loss, reflection measurements, and output port for signal gennerator and sweep modes.
2	Cal.	Provides gain adjustment to calibrate the detector.
3	Osc. On	LED is on whenever the internal Oscillator is on.
4	J2	Detector port for Reflected Power.
5	Detector	Detects and amplifies RF and Microwave Signals.

Table 2-2

Rear Panel Connector

Figure 2.2 Index No.	Connector	Function
1	To Model 7000A	Provides receptacle for interconnection with a 7000A through the 37 conductor cable, P/N 319067

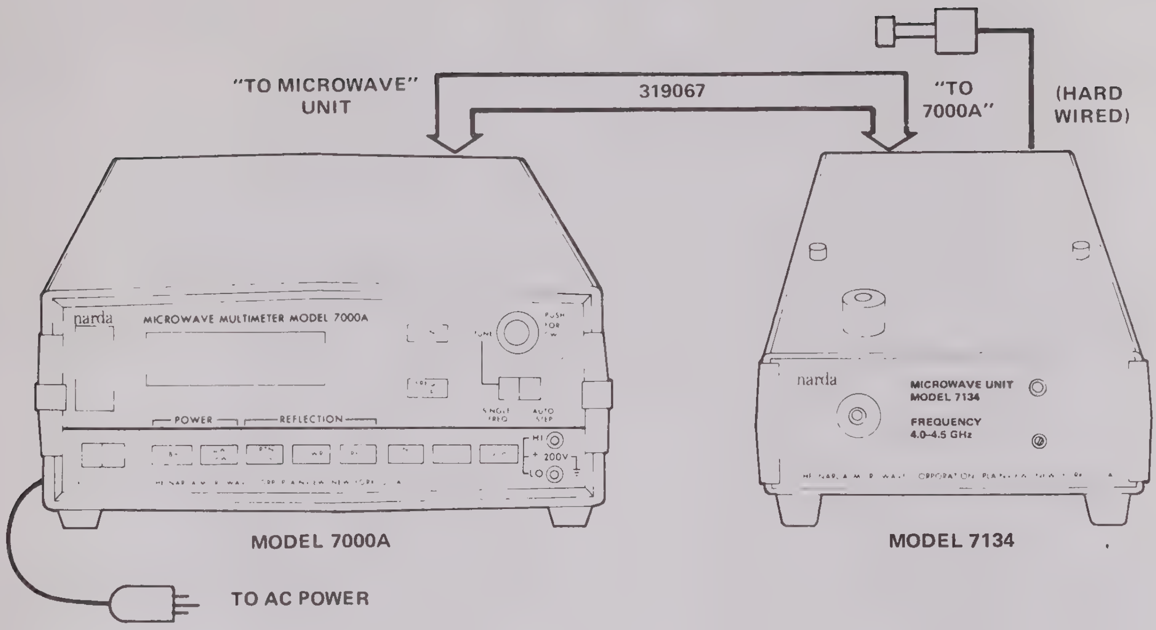

"TO MICROWAVE" UNIT
319067
"TO 7000A"
(HARD WIRED)
narda
MICROWAVE MULTIMETER MODEL 7000A
POWER
REFLECTION
SINGLE FREQ
AUTO STEP
HI
200V
LO
narda
MICROWAVE UNIT MODEL 7134
FREQUENCY 4.0-4.5 GHz
MODEL 7000A
MODEL 7134
TO AC POWER

Figure 2-3. Interconnection Diagram: 7000A To 7134

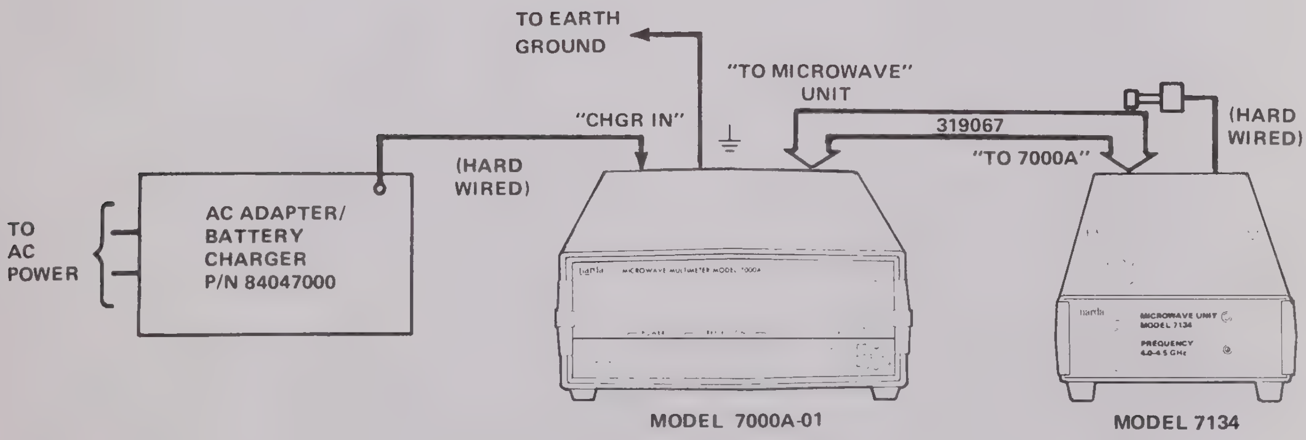

TO EARTH GROUND
"TO MICROWAVE" UNIT
"CHGR IN"
319067
"TO 7000A"
(HARD WIRED)
(HARD WIRED)
TO AC POWER
AC ADAPTER/ BATTERY CHARGER P/N 84047000
narda
MICROWAVE MULTIMETER MODEL 7000A
MICROWAVE UNIT MODEL 7134
FREQUENCY 4.0-4.5 GHz
MODEL 7000A-01
MODEL 7134

Figure 2-4. Interconnection Diagram: 7000A-01 To 7134

SECTION III

MICROWAVE UNIT THEORY OF OPERATION
NARDA Model 7134

3.1. INTRODUCTION.

This section discusses the theory of operation specific to the Model 7134 Microwave Unit. All theory concerned with operating the 7134 as part of the complete measurement system will be found in Section III of the Model 7000A Microwave Multimeter's Operation and Maintenance Manual.

3.2. DESCRIPTION.

The Model 7134 Microwave Unit consists of a voltage tuned 4.0 to 4.5 GHz transistor oscillator, a 4.0 to 4.5 GHz high directivity Attenucoupler, a .01 to 18 GHz zero bias schottky detector, and the electronics required for control and calibration of these devices. See Figure 3-1 for a block diagram of the microwave unit.

3.2.1. Internal Oscillator. The oscillator is turned on and off by the microprocessor with the OSC OFF signal to the bias control circuit. When bias is applied to the oscillator an RF frequency signal is produced. The frequency of this signal is controlled by the "V TUNE" signal through the varactor driver electronics. The output of the oscillator passes through an isolator to buffer the oscillator. The signal then passes through a low pass filter to reject all harmonics of the oscillator. The signal is then passed through the output Attenucoupler.

3.2.2. Detector. The detector is a zero bias schottky design sensitive to very low levels. The output of the detector is connected to a chopper amplifier for high AC gain and elimination of DC drifts typical of high gain circuits. The first stage of this amplifier is divided between the detector head and the RF board in the microwave unit.

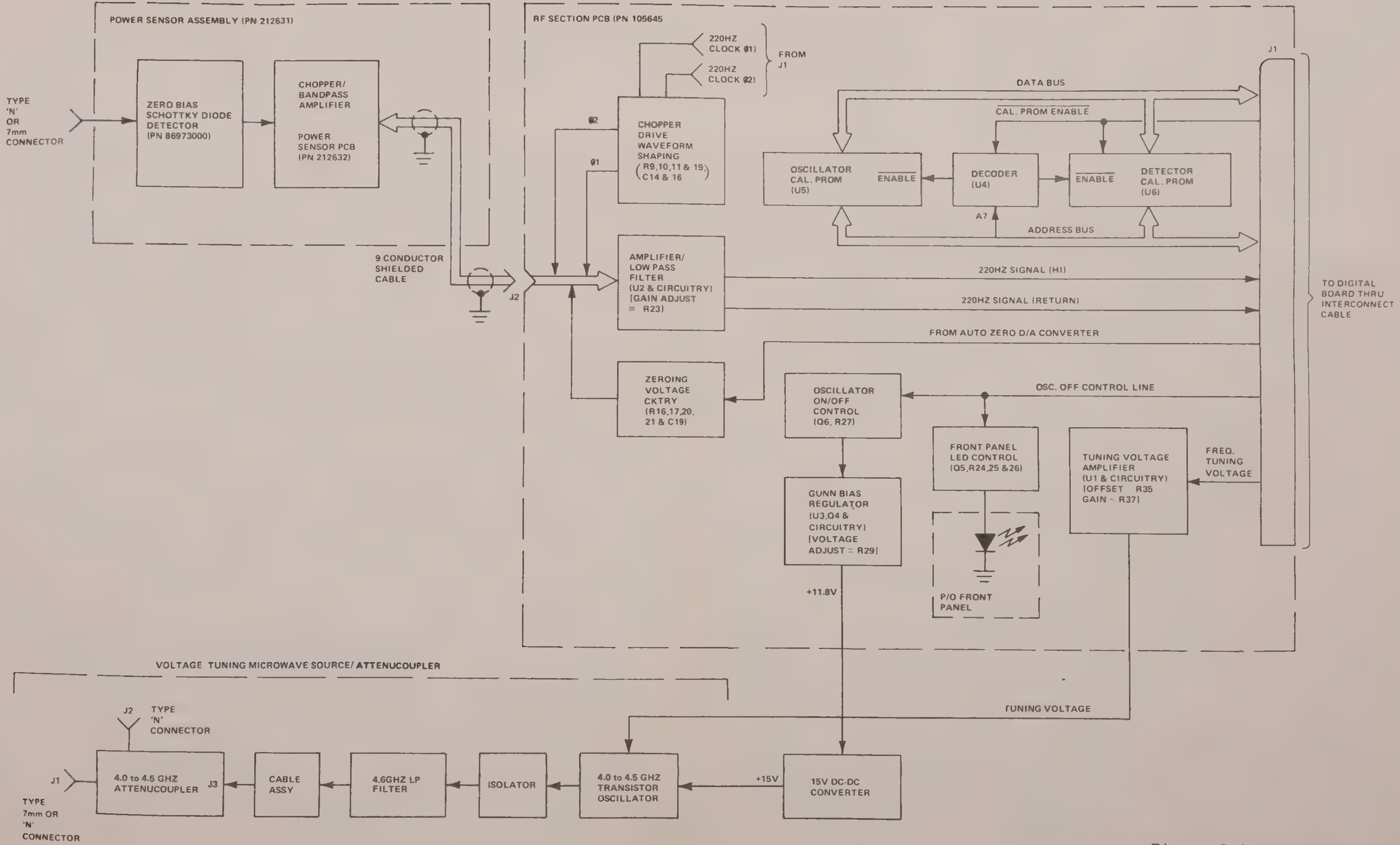

POWER SENSOR ASSEMBLY (PN 212631)
TYPE 'N' OR 7mm CONNECTOR
ZERO BIAS SCHOTTKY DIODE DETECTOR (PN 86973000)
CHOPPER/ BANDPASS AMPLIFIER
POWER SENSOR PCB (PN 212632)
9 CONDUCTOR SHIELDED CABLE
J2
RF SECTION PCB (PN 105645
220HZ CLOCK (Ø1)
220HZ CLOCK (Ø2)
FROM J1
Ø2
Ø1
CHOPPER DRIVE WAVEFORM SHAPING (R9,10,11 & 19, C14 & 16)
AMPLIFIER/ LOW PASS FILTER (U2 & CIRCUITRY) [GAIN ADJUST ≅ R23]
ZEROING VOLTAGE CKTRY (R16,17,20, 21 & C19)
DATA BUS
CAL. PROM ENABLE
OSCILLATOR CAL. PROM (U5)
ENABLE
DECODER (U4)
ENABLE
DETECTOR CAL. PROM (U6)
A7
ADDRESS BUS
J1
220HZ SIGNAL (HI)
220HZ SIGNAL (RETURN)
FROM AUTO ZERO D/A CONVERTER
OSC. OFF CONTROL LINE
TO DIGITAL BOARD THRU INTERCONNECT CABLE
OSCILLATOR ON/OFF CONTROL (Q6, R27)
GUNN BIAS REGULATOR (U3,Q4 & CIRCUITRY) [VOLTAGE ADJUST ≅ R29]
FRONT PANEL LED CONTROL (Q5,R24,25 & 26)
P/O FRONT PANEL
TUNING VOLTAGE AMPLIFIER (U1 & CIRCUITRY) [OFFSET R35 GAIN ~ R37]
FREQ. TUNING VOLTAGE
+11.8V
VOLTAGE TUNING MICROWAVE SOURCE/ ATTENUCOUPLER
TUNING VOLTAGE
J2
TYPE 'N' CONNECTOR
J1
4.0 to 4.5 GHZ ATTENUCOUPLER
J3
TYPE 7mm OR 'N' CONNECTOR
CABLE ASSY
4.6GHZ LP FILTER
ISOLATOR
4.0 to 4.5 GHZ TRANSISTOR OSCILLATOR
+15V
15V DC-DC CONVERTER

Figure 3-1. Block Diagram
Model 7134

3.2.3. Calibration Data. All calibration for both the internal oscillator and the microwave detector are stored in two calibration PROMS mounted on the RF board.

3.2.4. Attenucoupler. The Attenucoupler is a combination of a modified attenuator and high directivity coupler. The two components are permanently mated and the coupler is tuned for maximum directivity and low VSWR with the constant source impedance supplied by the Attenuator. The resulting unit has a minimum of 40 db directivity and a maximum VSWR of less than 1.08:1. Figure 3-2 shows the Attenucoupler and Figure 3-3 shows a typical directivity and VSWR curve for the Attenucoupler.

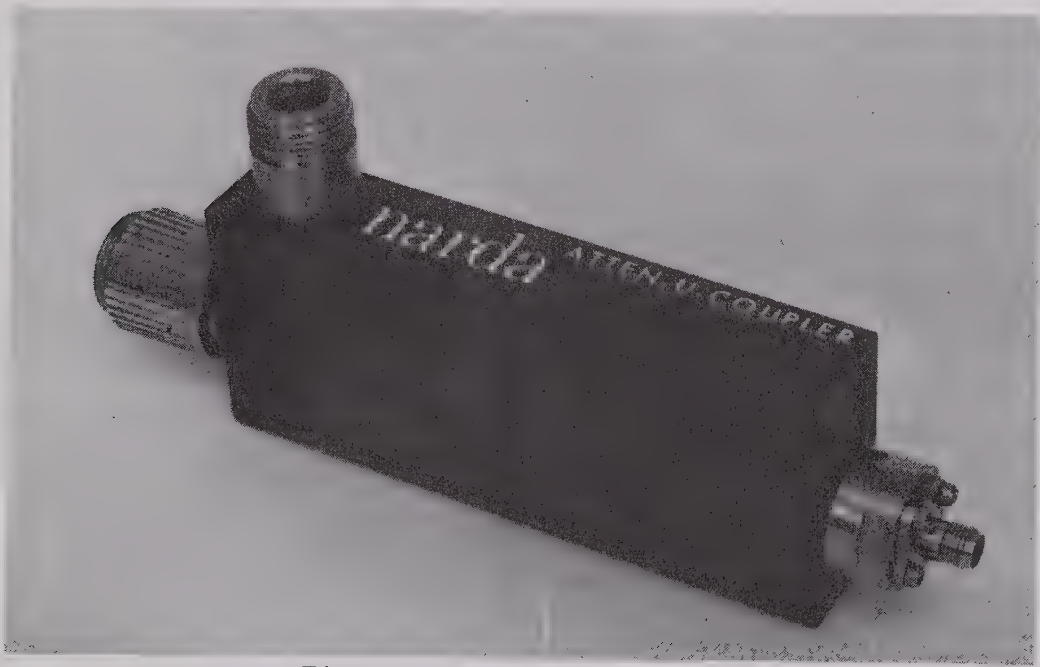


Figure 3-2. Attenucoupler

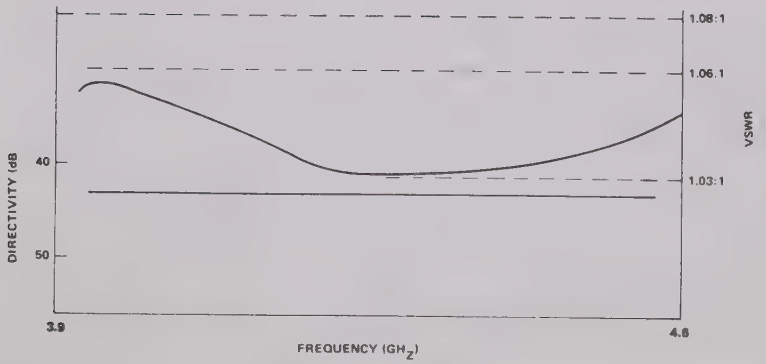


Figure 3-3. Attenucoupler Directivity and VSWR Curves (Typical)

3.3. BLOCK DIAGRAM DISCUSSION.

The block diagram for Model 7134 (Figure 3-1) can be divided into three main sections: the power sensor assembly, the RF section PC board and the tunable microwave source and Attenucoupler.

3.3.1. Power Sensor Assembly. The zero bias schottky diode detector converts the microwave signal level present at its input connector into a DC voltage. This DC voltage is then chopped into a square wave, filtered and amplified by the chopper/bandpass amplifier. This assembly is connected directly to the microwave section printed circuit board, Narda p/n 418919.

3.3.2. RF Section PC Board. The RF section PC board may be subdivided into three main areas: first, analog circuitry for the power meter, second digital calibration, and third, analog circuitry for microwave source control.

3.3.2.1. Analog Circuitry for the Power Meter. The chopped AC signal from the power sensor assembly is amplified and filtered by the amplifier/ low pass filter (U2) and sent through the 37 pin interconnect cable to the 7000A. The amplifier/low pass filter also supplies feedback and biasing to the power sensor assembly.

3.3.2.1.1. The chopper drive provides the two phase square wave input for the power sensor assembly's chopper.

3.3.2.1.2. The zeroing voltage circuitry shifts and divides down the auto-zero D/A converter voltage and sends it to the detector.

3.3.2.2. Digital Calibration. The detector calibration PROM (U6) contains the calibration data for the power sensor assembly. Two lists of data are contained in this PROM. First, the calibration factor versus input frequency chart, and second, the detector voltage versus input power chart are stored in this PROM.

3.3.2.2.1. The oscillator calibration PROM (U5) contains the tuning voltage input versus output frequency data for the 4.0 to 4.5 GHz transistor oscillator.

3.3.2.2.2. The decoder (U4) selects which calibration PROM will be enabled when the $\overline{\text{CAL PROM}}$ enable line is low (≤ .8V).

3.3.2.3. Analog Circuitry for Microwave Source Control. The tuning voltage amplifier (U1) amplifies the frequency tuning voltage coming from the 7000A to the voltage levels required by the 4.0 to 4.5 GHz transistor oscillator.

3.3.2.3.1. The front panel LED control turns the "OSC ON" LED on the 7134 front panel on and off depending upon the state of the "OSC OFF" control line.

3.3.2.3.2. The oscillator on/off control (Q6) turns the oscillator bias regulator on and off depending upon the state of the "OSC OFF" control line.

3.3.2.3.3. The gunn bias regulator supplies +11.8V to the DC/DC converter which raises it to 15V and is used as the oscillator bias.

3.3.3. Tunable Microwave Source/Attenucoupler. The 4.0 to 4.5 GHz transistor oscillator provides a microwave signal in the stated frequency range. The oscillator receives biasing current (from the DC/DC converter) through one terminal and tuning voltage through another terminal. This tuning voltage goes to a varactor diode in the oscillator.

3.3.3.1. The isolator provides a fixed load for the oscillator, isolating it from load variations at the output point. It also helps to match the line into the filter and attenucoupler.

3.3.3.2. The 4.6 GHz low pass filter suppresses the harmonics in the microwave signal.

3.3.3.3. The 4.0 to 4.5 GHz attenucoupler provides the test and reflected power ports for the 7134.

3.4. MISMATCH UNCERTAINTY.

3.5. The total accuracy of a measurement is the combination of instrument accuracy plus measurement uncertainty. Errors or uncertainties are introduced with the measurement or calibration of equipment because of the mismatch of devices when connected together. These mismatches are present because any device being measured or any device performing the measurement is not an ideal 50 ohm impedence. Therefore, mating together various devices, each with an imperfect VSWR or "mismatch," causes an uncertainty. The uncertainty results because the mismatch of a device prevents it from absorbing all the power incident upon it. These uncertainities exist for power, insertion loss or reflection measurements and are described in detail under paragraph 3.4.1, 3.4.2 and 3.4.3.

3.4.1. Mismatch Uncertainty for Power Measurement. The following equation describes mismatch uncertainties caused by the reflection coefficient of the power sensor and the source of power being measured. (ref. Figure 3-4.)

$$MU = 20 \log (1 \pm \rho_g \rho_D)$$

Where MU = Mismatch Uncertainty (maximum) in dB.

ρ_g = Generator Reflection Coefficiennt, RHO

ρ_D = Detector Reflection Coefficient, RHO

For the detector used in the Narda Model 7103, see Table 3-1 for worst case uncertainties when making power measurements of a power source having the VSWR's listed.

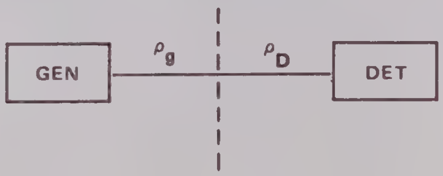


Figure 3-4. Power Meter Measurement Set-up

Table 3-1

Power Meter Measurement Uncertainty

$VSWR_g$	ρ_g	Freq. $\leq$ 4 GHz (ρ_D = 0.091)	4 GHz $\leq$ Freq. $\leq$ 18 GHz (ρ_D = 0.167)
1.10:1	.048	±.04 dB	±.07 dB
1.20:1	.091	±.07 dB	±.13 dB
1.50:1	.200	±.16 dB	±.30 dB
2.00:1	.333	±.26 dB	±.50 dB

3.4.2. Reflection Measurement Uncertainty. A typical reflection measurement set-up is shown in Figure 3-5. The measurement uncertainty of this set-up, in terms of a measurement of reflection coefficient RHO is:

$$MU = d \pm \left[\frac{(\rho_g \cdot T_1 \cdot T_2) + \rho_1}{1 - (\rho_g \cdot \rho_2)} \right] \cdot \rho_L^{2}$$

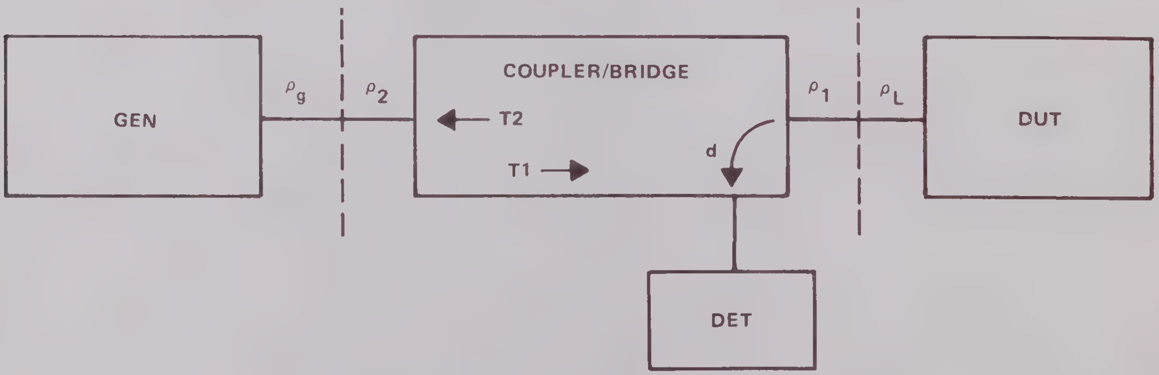
which is of the form:

Total Uncertainty = Uncertainty due to coupler directivity ± uncertainty due to test port mismatch

3.4.2.1. The term "d" in this equation is the directivity of the attenucoupler used in the 7134, which is 40 dB or 0.010. 'ρ' is the Greek letter RHO.

3.4.2.2. The internal oscillator impedance ρ_g is buffered by the isolator so that its effect is negligible. The attenuator's impedance is matched out with the input impedance of the coupler, reducing the ($\rho_g \rho_2$) term. As a result the term,

$$\left[\frac{\rho_g T_1 T_2 + \rho_1}{1 - \rho_g \rho_2} \right]$$ is reduced to .07.



$T_{1\&2}$ ≡ Through transmission of coupler/bridge $= 10^{\left(\frac{-\text{Ins. Loss In dB}}{20}\right)}$

d ≡ Directivity of coupler/bridge $= 10^{\left(\frac{-\text{Directivity In dB}}{20}\right)}$

DUT ≡ Device under test

Figure 3-5. Typical Reflection Measurement Set-up

3.4.2.3. The two terms described in paragraphs 3.4.2.1 and 3.4.2.2 combine to provide a total measurement uncertainty expressed by the following equation for the Model 7134.

$$MU = 0.010 \pm .07\ \rho_L{}^2$$

3.4.2.4. For comparison, the measurement uncertainty using catalog components would be expressed by the following equation:

$$MU = .018 \pm \left[\frac{.33\ (.994)^2 + .091}{1 - .33\ (.091)} \right] \rho_L{}^2$$

$$MU = \pm\ .018 \pm 0.4\ \rho^{2}L$$

3.4.2.4.1. As an example, using a signal generator typically having a source VSWR of 2:1 and assuming no cabling contribution the following uncertainties would result:

Generator:	VSWR	2.0:1	ρ_g =	.33
Coupler:	Insertion Loss	0.5 dB	T =	.944
	VSWR in	1.2	ρ_2 =	.091
	VSWR out	1.2	ρ_1 =	.091
	Directivity	35 dB	d =	.018

3.4.2.4.2. The insertion loss and VSWR values used in this equation are typical specifications of available couplers. It can be seen that signal generator impedance and test port VSWR cause a significant part of the uncertainty for measurements of high reflection coefficient and that the directivity of the coupler is most significant for low values of reflection coefficient.

Table 3-2

Reflection Measurement: 7134 Versus Typical Microwave Component Uncertainty

RHO			Return Loss		
ρ_L Actual	Typical Microwave Component Uncertainty	7134 Uncertainty	Actual Return Loss	Typical Microwave Component Uncertainty	7134 Uncertainty
.05	± .019	± .0102	-26 dB	+2.78 dB -4.17 dB	±2.01 dB
.1	± .022	± .0107	-20 dB	±1.73 dB	±.98 dB
.3	± .054	± .0163	-10.5 dB	±1.5 dB	±.44 dB

NOTES

1) Typical uncertainties refers to uncertainties that occur with directional couplers and sweepers having the typical specifications used in the example shown under 3.3.2.4.

2) 7134 uncertainty shows the improvement achieved by using the 7134 Microwave Unit.

3) Reflection uncertainty is calculated using the following identities:

$$\text{RTN Loss} = 20 \text{ LOG RHO}$$

$$\text{VSWR} = \frac{1 + \text{RHO}}{1 - \text{RHO}}$$

3.4.3. Transmission (insertion loss/gain) Measurement Uncertainty. A similar analysis can be done for transmission measurements. When the system is calibrated, there is a mismatch error in the calibration measurement. Figure 3-6 shows this set-up. Then, when the device under test is inserted, there are mismatch errors at both interfaces, as shown in Figure 3-7.

3.4.3.1. The total uncertainty equation for transmission (insertion loss/gain) is:

$$M\mu = 20 \log \left[\frac{(1 \pm \rho_g \cdot \rho_D)}{(1 \pm \rho_g \cdot \rho_3)\ (1 \pm \rho_4 \cdot \rho_L) \pm (\rho_g \cdot T1 \cdot T2 \cdot \rho_D)} \right]$$

3.4.3.1.1. To determine the accuracy of the measurement, it is essential to know the reflection coefficient of all components involved.

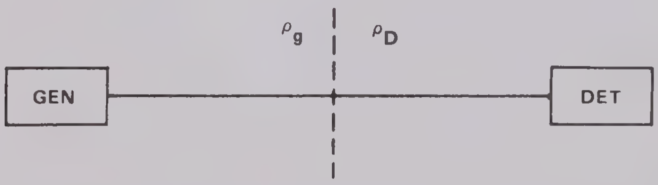


Figure 3-6. Insertion Loss Calibration Mismatch Error

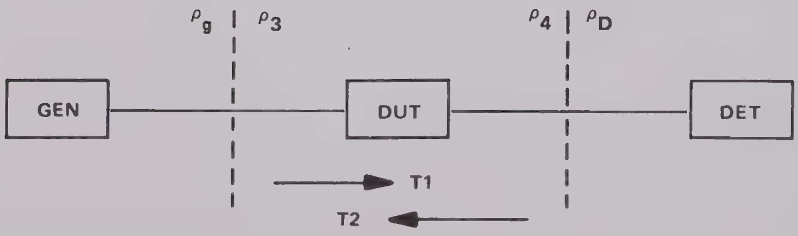


Figure 3-7. Insertion Loss Test Mismatch Error

3.4.3.1.2. By substituting the 7134 specifications ($\rho_g \leq .048$ and $\rho_D \leq .167$) mismatch uncertainties for transmission measurement can be reduced to:

$$M\mu = 20 \log \left[\frac{1 \pm .008}{(1 \pm .05\, \rho_3)\,(1 \pm .167\, \rho_4) \pm .008\, T_1\, T_2} \right]$$

Where:
ρ_g = Generator reflection (J1) coefficient.
ρ_D = Detector reflection coefficient.
ρ_3 = Input reflection coefficient of device under test
ρ_4 = Output reflection coefficient of device under test
$*T_1$ = Forward transmission ratio of device under test
$*T_2$ = Reverse transmission ratio of device under test

$$*T = 10^{\left(\frac{-\text{insertion loss in dB}}{20}\right)}$$

See Table 3-3 for transmission measurement uncertainties developed by using these equations.

3.4.3.1.3. Worst case measurement uncertainties that occur when making insertion loss measurements are shown in Table 3-3 for the devices listed.

Table 3-3

Transmission Measurement Uncertainties for Model 7134

Device Under Test		
Description	Input/Output VSWR (ρ)	Mμ (dB)
Attenuator 10 dB	1.10:1 (.048)	± .17
Attenuator 10 dB	1.20:1 (.091)	± .25
Attenuator 6 dB	1.20:1 (.091)	± .26
Attenuator 3 dB	1.20:1 (.091)	± .28

SECTION IV

MICROWAVE UNIT MAINTENANCE
NARDA Model 7134

4.1. INTRODUCTION.

Before starting maintenance, perform the "Interconnect and Turn-on Procedures" described under paragraph 2.6 in Section II of this manual, and check Table 4-1 for a list of required test equipment. If additional schematic or parts location information is needed for maintenance purposes, refer to Section VI of this manual. It is suggested that the 7134 and 7000A be calibrated together to save time.

4.2. FUNCTIONAL AND ACCURACY TESTS AND ADJUSTMENTS.

The multimeter (7134 Microwave Unit and 7000A or 7000A-01) that passes all functional and accuracy checks is fully operational to original manufacturer's specifications and many be returned to service. Adjustments describe procedure for aligning a unit that passes functional tests but does not meet accuracy specifications. The functional tests will systematically test one or several functional blocks of the microwave unit at a time while adding a minimum number of new functional blocks with each new test. The tests were designed this way to make troubleshooting the system easier, should a fault be found.

4.2.1. Calibrating a 7134 and 7000A (or 7000A-01) Together. When calibrating a 7134 Microwave Unit and multimeter together, refer to the microwave multimeter manual Section IV, paragraph 4.2. The functional and accuracy tests and adjustments described there, will calibrate most of the 7134 and all of the 7000A (or 7000A-01). After successfully completing all tests in the 7000A's manual, go to paragraph 4.2.6: test port (J1) output power test, in this manual, to complete the calibration of the 7134 Microwave Unit.

4.2.2. Calibrating a 7134 with a Calibrated 7000A (or 7000A-01). When calibrating a 7134 Microwave Unit with a calibrated 7000A, follow the procedures that begin under paragraph 4.2.3: preliminary instructions, in this manual.

Table 4-1

Required Test Equipment

Test No.	Description
1	7000A
or	
1A	7000A-01
2	37 PIN Interconnect cable NARDA P/N 319067 supplied with the multimeter.
3	4 1/2 digit DVM, RMS responding. Data Precision 2480R or equivalent.
4	Oscilloscope, with external sweep input capability. TEK 454 or equivalent.
5	Frequency Counter. 5 Hz-18 GHz, EIP 351 or equivalent
6	Crystal Detector. Narda Model 503 or equivalent.
7	Two BNC cables four feet long. Narda Model SBNCB-48
8	Source, + 10.0 mW ± .10 mW, 50 or 100 MHz.
or	
8A	Source + 1.0 mW + .01 mW, 50 or 100 MHz.
9	RF Source, Power out ≥ 100 mW, 50 or 100 MHz. HP8601 or equivalent.
10	Step Attenuator, 0-90 dB in 10 dB steps. HP 355D option .001, or equivalent.
11B	Step Attenuator, 0-9 dB in 1 dB steps. HP 335C option .001, or equivalent.
12	Power Meter
13	Attenuator 10 or 20 db with known VSWR and loss, 3.7-4.2 GHz (for insertion loss and Reflection Measurement Tests).

4.2.3. Preliminary Instructions. Following interconnect procedures outlined in paragraph 2.8 through 2.8.3 in Section II of this manual and before turning on the power switch, remove the top cover of the 7134 Microwave Unit by the following procedure:

4.2.3.1. Remove the four phillips head screws from the feet located on the bottom surface of the 7134 Microwave Unit.

4.2.3.2. Press down on the upper surface of the side bezel while prying the top from the body, to avoid complete disassembly of the 7134 case.

4.2.3.3. Set power switch to "ON" position. Over a period of approximately five seconds the LCD readout will display all segments illuminated as shown in Figure 2-7, Section II of the 7000A manual, followed by a brief display of the minimum and then maximum rated frequency points (GHz) of the 7134 Microwave Unit. During this time, the multimeter performs an internal self-test of the microprocessor, internal memories and program integrity. After these internal tests have been completed, the LCD readout will indicate that the multimeter is in the Volts mode. The LCD readout will display 0.000 plus or minus .003 volts.

4.2.3.4. If the multimeter does not turn on, check the line voltage and fuse as outlined under paragraph 2.5 in Section II of the 7000A manual.

4.2.4. Power Meter Test. Perform the following test to verify accuracy of the power meter section.

NOTE

> This test checks the accuracy of both the 7000A (or 7000A-01) multimeter and 7134 Microwave Unit, combining both accuracies under the heading of 7000A microwave multimeter accuracy.

4.2.4.1. Connect the equipment as shown in Figure 4-1.

4.2.4.2. Turn the reference power source off.

4.2.4.3. Press μW mW then 2nd and CALIB on the 7000A to select the power meter mode. Press CONT to cause the multimeter to auto zero.

4.2.4.4. Turn the "TUNE" pot on the front panel of the multimeter fully counterclockwise and press FREQ DISP to select the lowest frequency calibration factor (50 MHz). Press μW mW .

4.2.4.5. Turn the reference power source ON.

4.2.4.6. Adjust the calibration pot (CAL) on the front panel of the 7134 Microwave Unit until the correct input power is read on the multimeter's LCD. This adjustment should be maximum of 2 to 3% change.

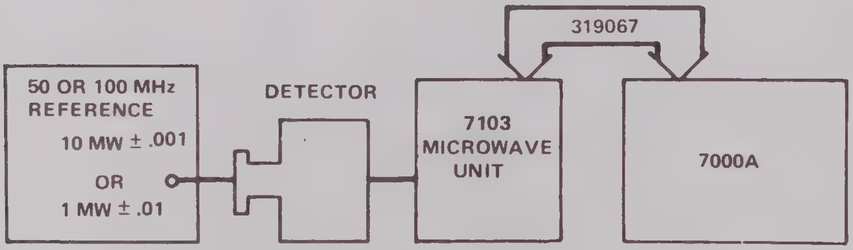


Figure 4-1. Power Meter Calibration/Gain Test

4.2.4.7. Power Meter Linearity Test. Connect the equipment as shown in Figure 4-2 and proceed as follows:

4.2.4.7.1. Press dBm , then press 2nd and CALIB . Follow calibration instructions given on the 7000A's LCD.

4.2.4.7.2. Set the 10 dB step attenuator to 10 dB and adjust the signal source for 10.00 dBM, as read on the 7000A's LCD.

4.2.4.7.3. Use both step attenuators to set values in 2 dB steps, from 10 dB to 70 dB and note that the multimeter reads the computed power levels to within the test set up and multimeter accuracies. Refer to 4.2.4.7.4. for Total Uncertainty computation. The accuracy specification for the multimeter with a calibrated microwave unit is ± 3% or (± .15 dB) assuming 0% calibration factor error. The total accuracy of the entire test setup shown in fig. 4-2 is ±.72 dB including step attenuator accuracy.

NOTE

> There are no range to range accuracy adjustments on the microwave unit. If accuracy is not within specified limits the detector and/or the detector cal PROM must be changed. See Table 4-2 for the memory map of the detector calibration PROM and paragraph 4.3.2. (Troubleshooting Faulty 7134).

4.2.4.7.4. Total Uncertainty For Power Meter Linearity Test.

Total uncertainty = Calibration test system uncertainty + 7000A uncertainty

Total uncertainty = [attenuation uncertainty of 1 db step attenuator + attenuation uncertainty of 10 db step attenuator + mismatch uncertainty of test port.] + [7000A uncertainty]

Substituting in the specifications for the listed equipment:

Total uncertainty = [± .25 db (1 db step) ± .25 db (10 db step)
± 20 log (1 + ρ_g ρ_D)] ± [.15 dB (7000A)]

Where: ρ_g = reflection coefficient at the test port (10 db step atten.)
ρ_D = reflection coeficicent of the detector (specification for ρ_g and ρ_D = .09)

Total uncertainty = [± .25 db ± .25 db ± .07 db] ± .15 db

Total uncertainty = ± 0.57 db ± .15 db = ± .72 db

Example: Step Attenuator at 32 db
calculated reading = + 10 dbm - (Δ step attenuation)*
= + 10 dbm - (22 dB)
= -12.00 dbm

therefore the 7000A should read -12.00 dbm ± 0.72 db

4.2.4.7.5. Total system uncertainty may be substantially reduced by calibrating the step attenuators at the calibration frequency before calibrating the multimeter. Referring to the total uncertainty computation in 4.2.4.7.4, ± .5 dB of the total ± .57 dB calibration test system uncertainty is caused by attenuation uncertainty.

4.2.4.7.6. A further reduction in calibration uncertainty may be made by adding a fixed 10 dB attenuator having a reflection coefficient ≤ .02 between the detector of the microwave unit and the 10 dB step attenuator. Narda fixed attenuators, 779 Series, typically have reflection coefficients of ≤ .02 at RF frequencies. Paragraph 4.2.4.7.7 provides an example of calibration uncertainty reduction.

4.2.4.7.8. As an example, if the test set-up of Figure 4-2A is used and is calibrated to an accuracy of ± .07 dB the accuracy of measurement can be improved to ± .09 dB. Substituting in the equation under paragraph 4.2.4.7.4:

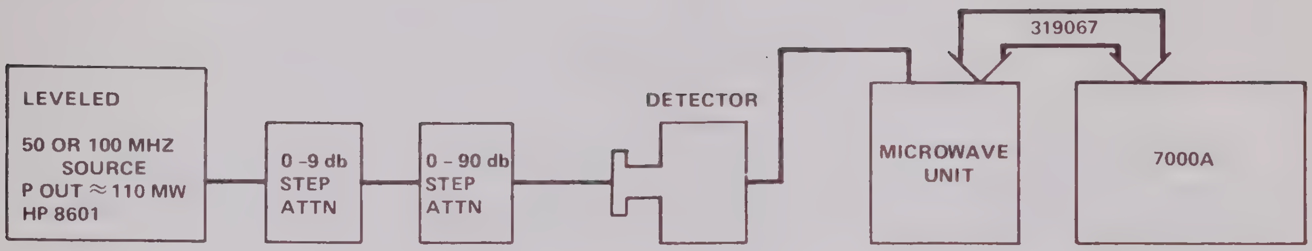
Total uncertainty = [± atten uncertainty ± 20 Log $(1 \pm \rho_g \cdot \rho_D)$]
± 7000A uncertainty

= [± .07 ± 20 Log (1 ± (.02 x .09))] ± .15 dB

= [± .07 ± .02] ± .15 db = .09 ± .15 dB

= ± .24 dB

*Δ Step attenuation is the difference between the step attenuator setting and the 10 dB that was used to set the reference +10 dBm level.


LEVELED
50 OR 100 MHZ
SOURCE
P OUT ≈ 110 MW
HP 8601
0 -9 db
STEP
ATTN
0 - 90 db
STEP
ATTN
DETECTOR
319067
MICROWAVE
UNIT
7000A

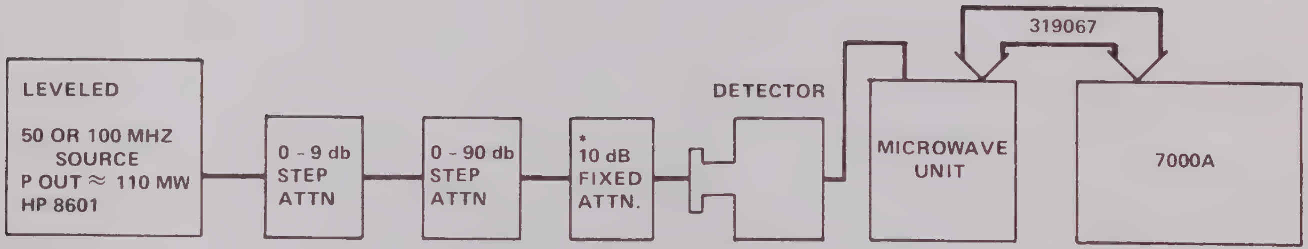
CONTROL SETTINGS:

SOURCE: FREQ: 50 OR 100 MHZ
POWER OUT: ≈ 110 MW
LEVELING: SOURCE MUST BE LEVELED

ATTENUATORS: 0 - 9 db : 0 db
0 - 90 db : 90 db

7000A: SEE TEXT

Figure 4-2. Power Meter Linearity Test


LEVELED
50 OR 100 MHZ
SOURCE
P OUT ≈ 110 MW
HP 8601
0 - 9 db
STEP
ATTN
0 - 90 db
STEP
ATTN
*
10 dB
FIXED
ATTN.
DETECTOR
319067
MICROWAVE
UNIT
7000A

*NARDA MODEL 779-10 FIXED 10 dB PAD SELECTED
FOR VSWR $<$1.05 AT THE TEST FREQUENCY
(50 MHZ OR 100 MHZ)

Figure 4-2A. High Precision Power Meter Linearity Test

Table 4-2

Detector Calibration Prom (U6) Memory Map

Address	Data Function	Typical Data
00	Calibration Factor at 50 MHZ	100*
01	Calibration Factor at 1.024 GHZ	99
02	Calibration Factor at 2.048 GHZ	98
03 → 16	Calibration Factors for 3.072 GHZ to 16.384 GHz (every 1.024 GHZ)	99 - 90 general trend decreasing
17	Calibration Factor for 17.408 GHZ	92
18	Calibration Factor for 18.0 GHZ	90
19 & 20	Repeat of Calibration Factor for 18.0 GHZ	90, 90
21 & 22	Detector Voltage for -30 dBm (1.00 μw)	24*
23 & 24	Detector Voltage for -28.0 dBm	38*
25 & 26	Detector Voltage for -26.0 dBm	60*
27 & 28	Detector Voltage for -24.0 dBm	95
29 & 30	Detector Voltage for -22.0 dBm	146
31 & 32	Detector Voltage for -20.0 dBm (10.0 μw)	230
33 & 34	Detector Voltage for -18.0 dBm	350
35 & 36	Detector Voltage for -16.0 dBm	550
37 & 38	Detector Voltage for -14.0 dBm	800
39 & 40	Detector Voltage for -12.0 dBm	1,200
41 & 42	Detector Voltage for -10.0 dBm (100 μw)	1,700
43 & 44	Detector Voltage for -8.0 dBm	2,400
45 & 46	Detector Voltage for -6.0 dBm	3,400
47 & 48	Detector Voltage for -4.0 dBm	4,600
49 & 50	Detector Voltage for -2.0 dBm	6,300
51 & 52	Detector Voltage for 0.0 dBm (1.00 mw)	8,400
53 & 54	Detector Voltage for + 2.0 dBm	11,100
55 & 56	Detector Voltage for + 4.0 dBm	14,600
57 & 58	Detector Voltage for + 6.0 dBm	19,200
59 & 60	Detector Voltage for + 8.0 dBm	24,800
61 & 62	Detector Voltage for + 10.0 dbm (10.0 mw)	32,000
63 & 64	Detector Voltage for + 12.0 dBm	40,000
65 → 67	For Narda internal Bookkeeping - not used by Multimeter	--
68 → 251	Not used	255 (unprogrammed)

*This data is exact for all 7134's.

**Detector Voltage data is used by the 7000A to correct for the changing gain of the detector as it goes from its square law region to its linear region as power increases. See the 7000A's manual, Section III, for the theoretical discussion.

The equation for Detector Voltage is:

$$\text{Detector Voltage} = \left(\frac{\Delta\ \text{Voltage at COMPARATOR of 7000A}}{\text{GAIN REFERENCE}}\right) \times 24{,}576$$

where: Δ Voltage at COMPARATOR = (Voltage at A3, U15, pin 3 with Power applied) - (Voltage at A3, U15, pin 3 with no Power applied) (in the same range)

and GAIN REFERENCE = 1024 for POWER ≈ -38 To -27 dBM
256 for POWER ≈ -27 To -21 dBM
64 for POWER ≈ -21 → -15 dBM
4 for POWER ≈ -15 → -+4 dBM
1 for POWER ≈ +4 → +12 dbm

NOTES

1. Δ Voltage at comparator is set for 1.000V at a power level of 1.000 μw (-30.0 dBM) using the CAL. ADJUST CONTROL on the 7134. This is consistent with the Detector Calibration PROM Memory Map, in that: Detector Voltage = $\frac{1.000V}{1024} \times 24576 = 24$ which is always true at -30.0 dBM for the 7134.

2. The power levels for a given range (i.e. gain reference) will vary approximately ± 1 db from unit to unit depending upon the shape of the volts vs. power input for the 7134's detector. See the 7000A's theory of operation, Section III, for discussion of this curve.

4.2.5. Signal Generator Test. After completing the power meter test, perform the following test to verify accuracy of the signal generator section.

4.2.5.1. Connect the equipment as shown in Figure 4-3 and proceed as follows:

4.2.5.2. Press VDC and note that the "OSC ON" LED located on the microwave unit's front panel is off.

4.2.5.3. Press 2nd and SIG GEN and note that the "OSC ON" LED is now on.

4.2.5.4. Press 2nd and then 52 PTS . Press 2nd and then DISP WAIT. Press INS LOSS , 2nd and then CALIB . Remove the detector from any source of RF power and then press CONT twice.

4.2.5.5. When "dut" is displayed on the multimeter's LCD, press CONT . The counter should read 4.00 ± .020 GHz. Adjust A1R34 (oscillator offset) for compliance. The oscillator will only remain on for approx. 1/2 sec (440 m sec) so it may be necessary to repeat this step several times. To restart the stepped run at 4.0 GHz press INS LOSS. To procede to the next freq. press CONT .

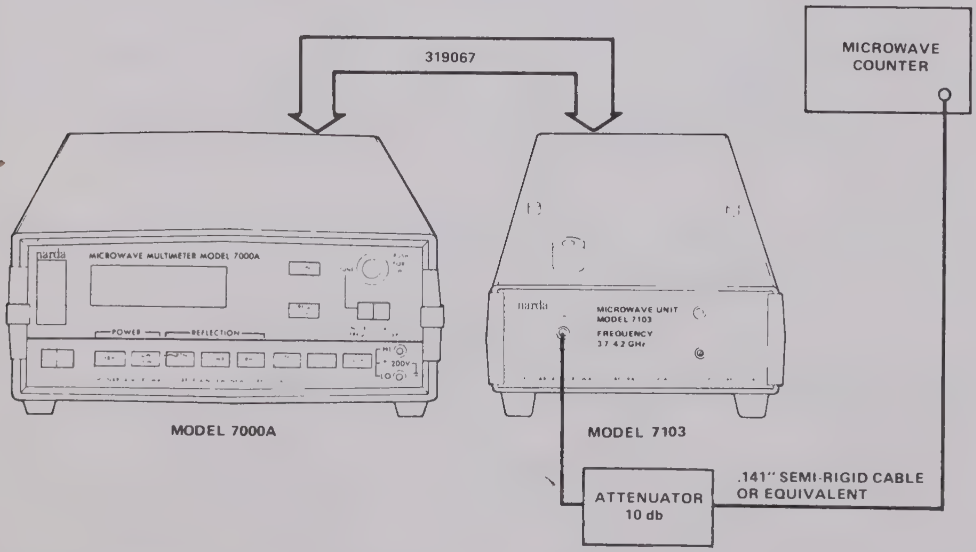

319067
MICROWAVE COUNTER
narda
MICROWAVE MULTIMETER MODEL 7000A
POWER
REFLECTION
200V
MODEL 7000A
narda
MICROWAVE UNIT MODEL 7103
FREQUENCY 3.7-4.2 GHz
MODEL 7103
ATTENUATOR 10 db
.141" SEMI-RIGID CABLE OR EQUIVALENT

Figure 4-3. Signal Generator Test with 7100 Series Microwave Unit

4.2.5.5.1. As CONT is repetitively pressed fifty times at intervals of two or more seconds, the frequency on the counter should move in fifty equally spaced steps from 4.0 to 4.5 GHz. The frequency at each step should be within 20 MHz of the expected frequency.

4.2.5.5.2. Adjust R37 (oscillator Gain) for compliance.

NOTE

> FREQ DISP may be pressed at any time during the signal generator test to display the frequency on the multimeter's LCD that should be read on the counter. The difference between the LCD and the counter is the frequency error. Pressing FREQ DISP will not increment the multimeter in the next frequency step.

4.2.5.5.3. After the multimeter has been stepped through the microwave unit's full frequency range, press 2nd and MIN MAX .

4.2.5.5.4. Press 2nd and SIG GEN . Rotate the "TUNE" control knob on the front panel of the multimeter full counterclockwise and note that the minimum frequency displayed on the counter is below 4.0 GHz. Rotating the knob full clockwise will display a maximum frequency that is higher than 4.5 GHz. See Table 4-3 for the memory map and calibration equation of the oscillator calibration PROM.

Table 4-3

Oscillator Calibration PROM (U5) Memory Map

Address	Data Function	Typical Data
00	Minimum Rated Freq. of OSC (4,000 MHz) in 100 MHz increments	40*
01	Maximum Rated Freq. of OSC. (4,500 MHz) in 100 MHz increments	45*
02 & 03	Tuning Voltage at 4.00 GHz	91**
04 & 05	Tuning Voltage at 4.05 GHz	133
06 & 07	Tuning Voltage at 4.10 GHz	181
08 & 09	Tuning Voltage at 4.15 GHz	233
10 & 11	Tuning Voltage at 4.20 GHz	293
12 & 13	Tuning Voltage at 4.25 GHz	351
14 & 15	Tuning Voltage at 4.30 GHz	419
16 & 17	Tuning Voltage at 4.35 GHz	488
18 & 19	Tuning Voltage at 4.40 GHz	568
20 & 21	Tuning Voltage at 4.45 GHz	655
22 & 23	Tuning Voltage at 4.50 GHz	754
24 - 27	Date of Calibration - Not used by multimeter	--
28 - 31	Identification number of oscillator - not used by multimeter	--

*All 7134's

**The equation defining the relationship between the stored data and the tuning voltage from the 7000A (which can be measured at A1TP3 of the 7134) is:

Tuning Voltage = (STORED NUMBER/1023) X 10.0V

e.g. For data given at 4.5 GHz: TUNING VOLTAGE = (754/1023) x 10.0V

= 7.370V @ A1TP3

NOTE

All numbers given here are decimal. Numbers are stored in the calibration PROM in binary.

NOTE

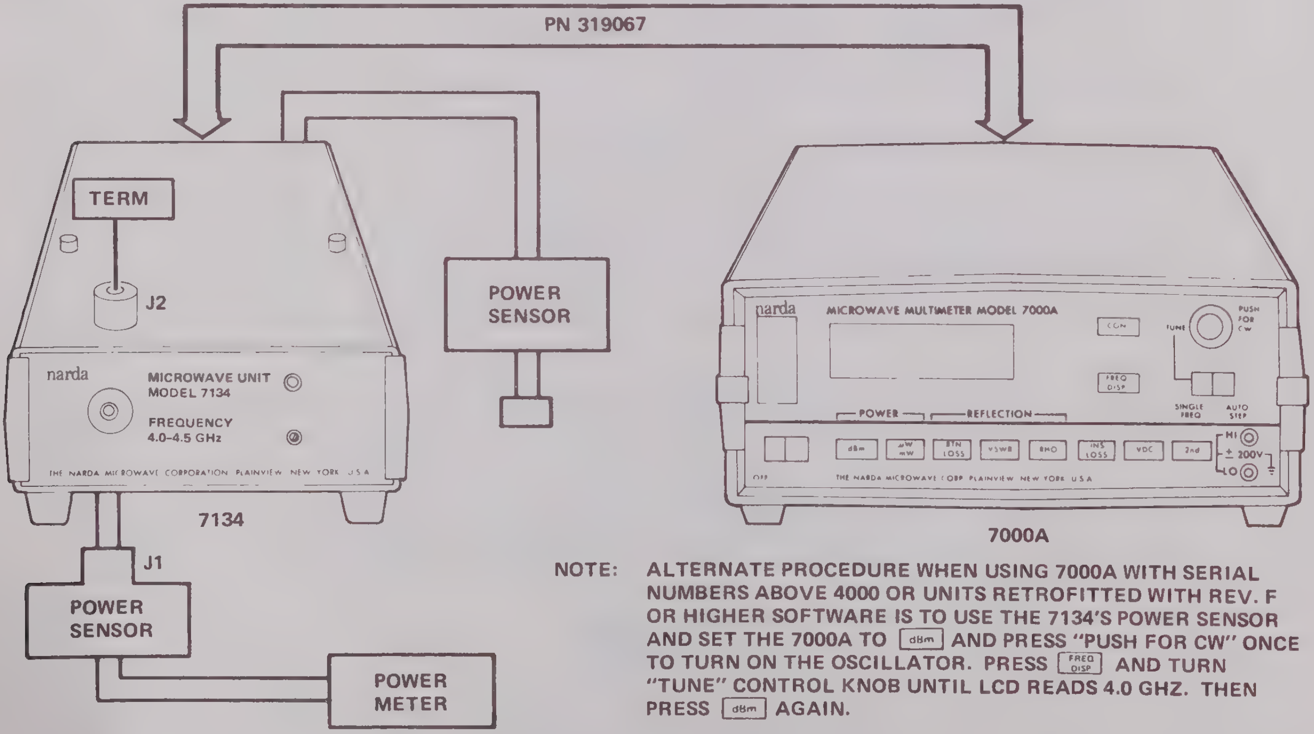
This is the entry paragraph from the calibration procedure in the 7000A manual (when calibrating the 7000A and 7134 simultaneously).

4.2.6. Test Port (J1) Output Power Test. After completing the calibration procedures in the microwave multimeter manual as required under 4.2.1 in this manual, "Calibrating a 7134 and 7000A or 7000A-01) Together," proceed as follows to finish calibrating the 7134:

4.2.6.1. Connect the equipment as shown in Figure 4-4.

4.2.6.2. Press the 2nd and SIG GEN buttons on the 7000A. Adjust the "TUNE" control knob for 4.0 GHz on the LCD.

4.2.6.3. While monitoring the power meter reading, slowly turn the "TUNE" control knob clockwise until the LCD reads 4.5 GHz.


PN 319067
TERM
J2
POWER SENSOR
narda
MICROWAVE UNIT MODEL 7134
FREQUENCY 4.0-4.5 GHz
THE NARDA MICROWAVE CORPORATION PLAINVIEW NEW YORK U.S.A.
7134
J1
POWER SENSOR
POWER METER
narda
MICROWAVE MULTIMETER MODEL 7000A
TUNE
PUSH FOR CW
FREQ DISP
SINGLE FREQ
AUTO STEP
POWER
REFLECTION
dBm
μW mW
RTN LOSS
VSWR
RHO
INS LOSS
VDC
2nd
HI
± 200V
LO
THE NARDA MICROWAVE CORP PLAINVIEW NEW YORK U.S.A.
7000A

NOTE: ALTERNATE PROCEDURE WHEN USING 7000A WITH SERIAL NUMBERS ABOVE 4000 OR UNITS RETROFITTED WITH REV. F OR HIGHER SOFTWARE IS TO USE THE 7134'S POWER SENSOR AND SET THE 7000A TO dBm AND PRESS "PUSH FOR CW" ONCE TO TURN ON THE OSCILLATOR. PRESS FREQ DISP AND TURN "TUNE" CONTROL KNOB UNTIL LCD READS 4.0 GHZ. THEN PRESS dBm AGAIN.

Figure 4-4. Test Port (J1) Output Power Test Set-up

4.2.6.4. The power out of the test port should be between 0 and +5 dbm across the entire band. The variation from minimum to maximum power should be ± 2 db (4 db peak to peak) or less.

NOTE

> There are no adjustments for the test port (J1) output power test.

4.2.7. Insertion Loss Test. Proceed as follows:

4.2.7.1. Measure the insertion loss of an attenuator whose attenuation values and VSWR are precisely known (in the 4.0 to 4.5 GHz frequency range). Use the procedures given on the 7000A's cover, and follow the instructions displayed on the 7000A's LCD.

4.2.7.2. Compare data obtained by use of the microwave multimeter (7000A/7134) to the corresponding known values of the attenuator. The errors should be within the accuracy specifications for the multimeter [± .15 db (7000A + linearization specification) ± mismatch uncertainty].

4.2.7.3. Refer to mismatch uncertainty in Section III of this manual for the equation and sample calculation chart of insertion loss mismatch uncertainty.

NOTE

> There are no adjustments for the Insertion loss test.

4.2.8. Reflection Measurement. Proceed as follows:

4.2.8.1. Measure the reflection magnitude of the attenuator used in the previous (insertion loss) test in either RTN LOSS , VSWR or RHO display mode. Use the procedures given on the 7000A's cover and follow the instructions displayed on the 7000A's LCD.

4.2.8.2. Compare data obtained by use of the microwave multimeter (7000A/7134) to the corresponding known values of the attenuator. The errors should be within the accuracy specifications for the multimeter [± 3% (.15 dB) ± directivity error ± mismatch error].

4.2.8.3. Refer to mismatch uncertainty in Section III of this manual for the equation and sample calculation chart of reflection measurement uncertainties.

NOTE

There are no adjustments for the reflection measurement test.

NOTE

No accuracy test for the frequency calibration factors of the power meter has been specified in this section because many calibration departments do not have the equipment needed to perform an accurate test. Labs that have the necessary equipment usually have their own specified procedure for testing the calibration factors of a power meter. See Table 4-2 for the memory map of the detector calibration PROM. To set the 7000A for a CAL. factor of 100 simply rotate the tune control full ccw and then press FREQ DISP and dBm or µW mW .

4.3. TROUBLESHOOTING.

Do not attempt any troubleshooting task without first reading all of the procedures listed under this paragraph.

4.3.1. Fault Location. If it is not known whether a system fault is caused by the 7000A or the 7134, refer to Section IV, Troubleshooting, paragraphs 4.5 through 4.7 in the 7000A manual. Using the procedures described there will isolate the fault to the defective PC board (or section thereof) in either the 7000A or the 7134.

4.3.1.1. The fault is in the 7134 if the 7000A (or 7000A-01) and 7103 operate together properly either for all tests in this manual from 4.2.3 through completion of 4.2.5 or for all functional and accuracy tests in the microwave multimeter manual.

.3.1.2. When troubleshooting several 7000A's (and/or 7000A-01's) and Model 7134 Microwave Units together, the substitution method is probably the most efficient way of localizing a fault either to the 7000A (or 7000A-01) or to the 7134.

4.3.2. Troubleshooting a Faulty 7134. The following comments and charts will aid in troubleshooting, after the fault has been localized to the 7134.

4.3.2.1. Determine which mode(s) in non-functional, and proceed to the appropriate table. Table 4-4 covers power meter mode problems; Table 4-5 covers signal generator mode problems; Table 4-6 covers insertion loss and reflection mode problems when neither mode is accurate, and Table 4-7 covers reflection mode problems when the insertion loss mode is accurate.

4.3.2.1.1. If either the power meter mode (other than calibration factor error) or the signal generator mode is defective, the insertion loss and reflection modes will also be defective.

.3.2.1.2. If the problem is in the power meter mode, apply a 1 mW (0 dBM) test signal level to the detector while the 7000A (or 7000A-01) is in the power meter mode (either dBm or µW mW). Monitor and compare the waveform at the PC board's TP1 to the waveform shown in Figure 4-5.

4.3.2.1.3. To obtain steady state waveforms, jumper the digital (A2) board's TP2 to TP3 in the 7000A (or 7000A-01).

4.3.2.1.4. If the waveform at the 7134's (A1) board's TP1 is not correct, open the power sensor assembly. (Remove the four phillips head screws from the top of the assembly and slide the top section down the cable.) Compare the waveforms to those shown in Figure 4-5. Use external triggering on the oscilloscope. Trigger on the negative going edge of the E5 waveform, or the positive going edge of the E6 waveform. If any components in the power sensor assembly are replaced the calibration given in paragraphs 4.2.4 - 4.2.4.7.3 should be performed.

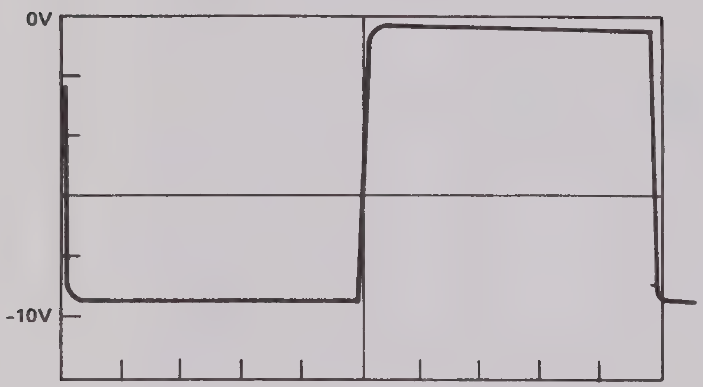
NOTE

For these waveform comparisons it is not necessary for the unit to be capable of being zeroed, because all amplitudes given are approximate. The zeroing voltage will not change the amplitude by any noticeable degree at this level of testing.

NOTE: AMPLITUDES SHOWN ARE APPROXIMATE AND WILL VARY SLIGHTLY FROM UNIT TO UNIT. THE PHASING OF ALL WAVEFORMS ARE SHOWN RELATIVE TO THE NEGATIVE GOING EDGE OF THE SQUAREWAVE AT E5(220HZ CLOCK, Ø2).

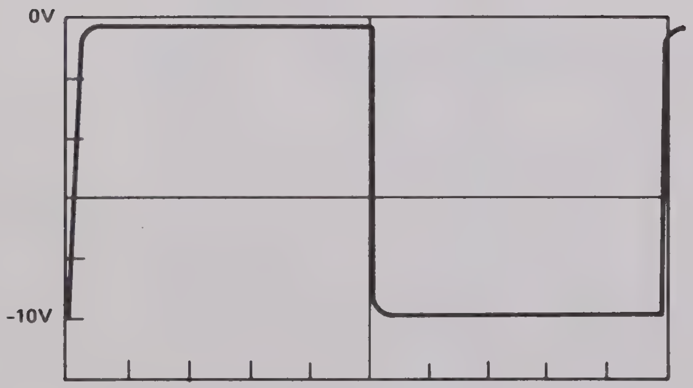
TIME BASE FOR ALL WAVEFORMS: 0.45 msec/DIV

POWER SENSOR: E5: Ø2, 2.0V/DIV



NOTE: MAY ALSO BE MEASURED ON A1PCB AT JUNCTION OF R9 & R10.

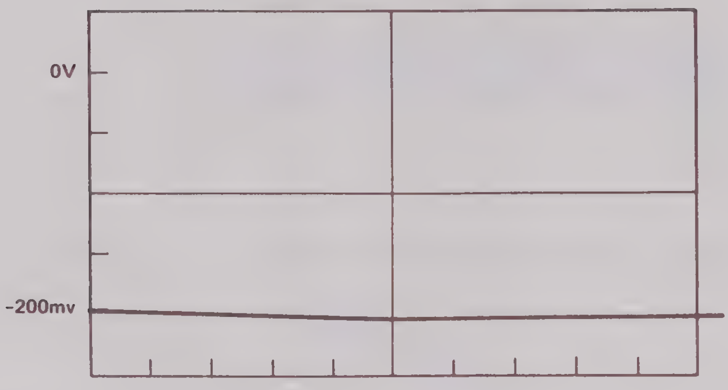
POWER SENSOR: E6: Ø1, 2.0V/DIV



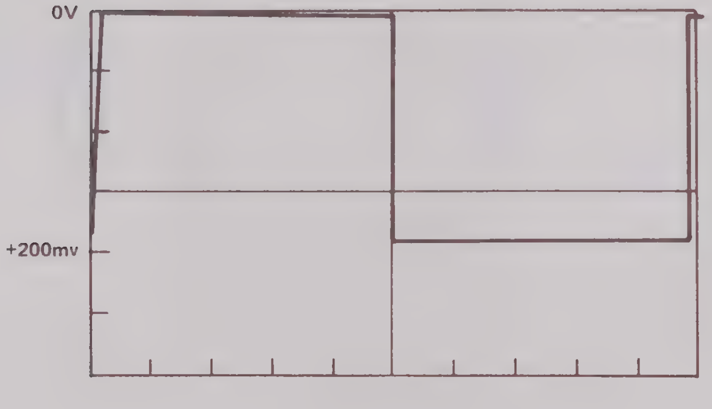
NOTE: MAY ALSO BE MEASURED ON A1PCB AT JUNCTION OF R11 & R14.

Figure 4-5. Waveforms for Power Meter Section
(Sheet 1 of 3)

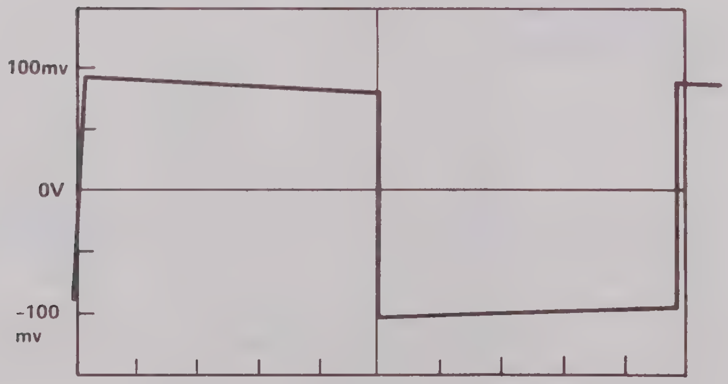
POWER SENSOR E11: 50mv/DIV



POWER SENSOR: JUNCTION Q1, Q2 & C3: 50mv/DIV



POWER SENSOR: JUNCTION C3 & Q3: 50mv/DIV



NOTE:
WAVEFORM ON
EM OF Q3 SHOULD
BE THE SAME
EXCEPT SHIFTED
DOWN APPROX.
-700mV.

NOTE:
COLLECTOR OF Q3 SHOULD BE AT A DC VOLTAGE LEVEL OF -50mv ±100mV WITH AN AC SIGNAL LESS THAN $5mV_{p-p}$ (EXCLUDING SWITCHING TRANSIENTS IN SYNC. WITH 220HZ CLOCK)

Figure 4-5. Waveforms for Power Meter Section (Sheet 2 of 3)

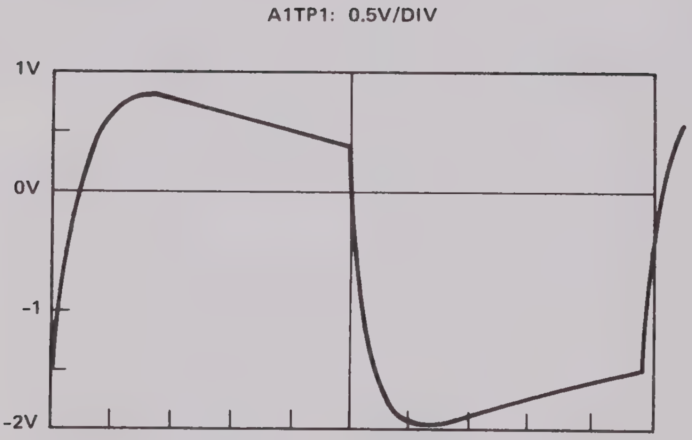


Figure 4-5. Waveforms for Power Meter Section
(Sheet 3 of 3)

Table 4-4

Power Meter Mode Problems*

Problem	Most Probable Causes
Will not zero	1. A1J2 or A1J1 connection not made solidly 2. Auto zero voltage not going to Power Sensor (Voltage at junction of A1R16 and R17 (and power sensor E2 terminal) should step from approximately -100 mV to +100 mV as unit attempts to auto-zero). 3. Power Sensor not removed from RF power source. 4. Interconnect cable (PN 319067) defective
Excessive noise at low power.	1. A1J1 or A1J2 connection not made solidly. 2. A1U2 noisy. 3. Q3 on power sensor noisy. 4. Q1 or Q2 on power sensor noisy.
Reads power accurately only below -30 dbm	1. A1U4 defective. 2. A1U6 defective. 3. $\overline{\text{Calprm}}$ signal not getting to U4 and U6 (PN 319067-interconnect cable defective)

*Check 1 mw input level waveforms before using this chart (which assumes waveforms were correct).

Table 4-4 (Cont,

Problem	Most Probable Causes
Reads power accurately only to a power level below specified maximum or at all powers except over a narrow range of power levels.	1. U6 defective.
Reads power accurately only over a frequency range less than .01 to 18 GHz.	1. U6 defective. 2. Detector in power sensor defective. Check: sweep the detector for return loss from 1-18 GHz. Check data against specs.

Table 4-5

Signal Generator Mode Problems

Problem	Most Probable Causes
No power out (J1) and "OSC ON" LED always off.	1. A1J1 connection to 37 pin interconnect cable not solid - Check A1TP2 "OSC OFF" signal level (≤ .8V OSC ON, ≥ 2.8V OSC. OFF).
"OSC ON" LED does not illuminate	1. A1Q5 defective. 2. CR1 defective. ("OSC ON" LED)
Output o.k. in "Sweep Generator" mode but N.G. in "Sig Gen".	1. RF source subassembly defective.
No output power or low power in "Sweep Generator" or "Signal Generator" mode.	1. RF source subassembly defective. 2. A1Q6 defective. 3. A1U3 defective. 4. A1Q4 defective. Check for proper bias level at A1E3: +15V 5. A4 (Attenucoupler) defective - Check for damaged output connector (J1).
Osc always on.	1. Bias Regulator (Q3, Q4, U3 + CKTRY) defective.
Frequency does not change in "Sig Gen" or "Sweep Gen" modes (connect wavemeter and ext. detector to J1 to measure swept frequency).	1. VTUNE not getting to tuning amplifier (A1TP3) - A1J1 connection not solid. 2. Tuning amplifier (U1 & CKTRY) defective. Measure voltage at A1E6 and compare to "Typical Frequency vs. Tuning voltage curve for 7134 "Figure 4-6 while in "Signal Generator" mode. 3. RF source subassembly defective.

Table 4-5 (Cont)

Problem	Most Probable Causes
Frequency changes but not over the entire band in both "Signal Generator" and "Sweep Generator" modes.	1. Tuning amplifier (U1 & cktry) defective. Check voltage at A1E6 against "Typical Frequency vs. Tunning Voltage Curve for 7134" Figure 4-6 2. RF source subassembly is defective.
Frequency tunes over entire band in "Signal Generator" mode but displayed frequency on LCD not accurate.	1. U4 or U5 is defective or RF source subassmbly is defective. Check: Place unit in "Sweep Generator" mode, and connect scope probe to A1E6. Externally sweep oscilloscope with "Sweep out" voltage of BNC connector on 7000A's rear panel. Compare to "Typical Frequency vs. Tuning Voltage Curve for 7134" Figure 4-6 1) if displayed curve has no correlation to referenced curve - U4 or U5 is defective. 2) curve is basically correct except for one or two 50 MHz segments - U5 is defective. 3) If displayed curve is monotonic and within minimum and maximum limits - RF source subassembly is defective. NOTES 1) The displayed trace, while having the same shape as the Typical Curve, will be composed of 5 segments between each bright spot (calibration frequency). 2) A gradually increasing error may be correct by readjusting A1R35 and A1R37 - see the adjustment section, paragraph 4.5.2.

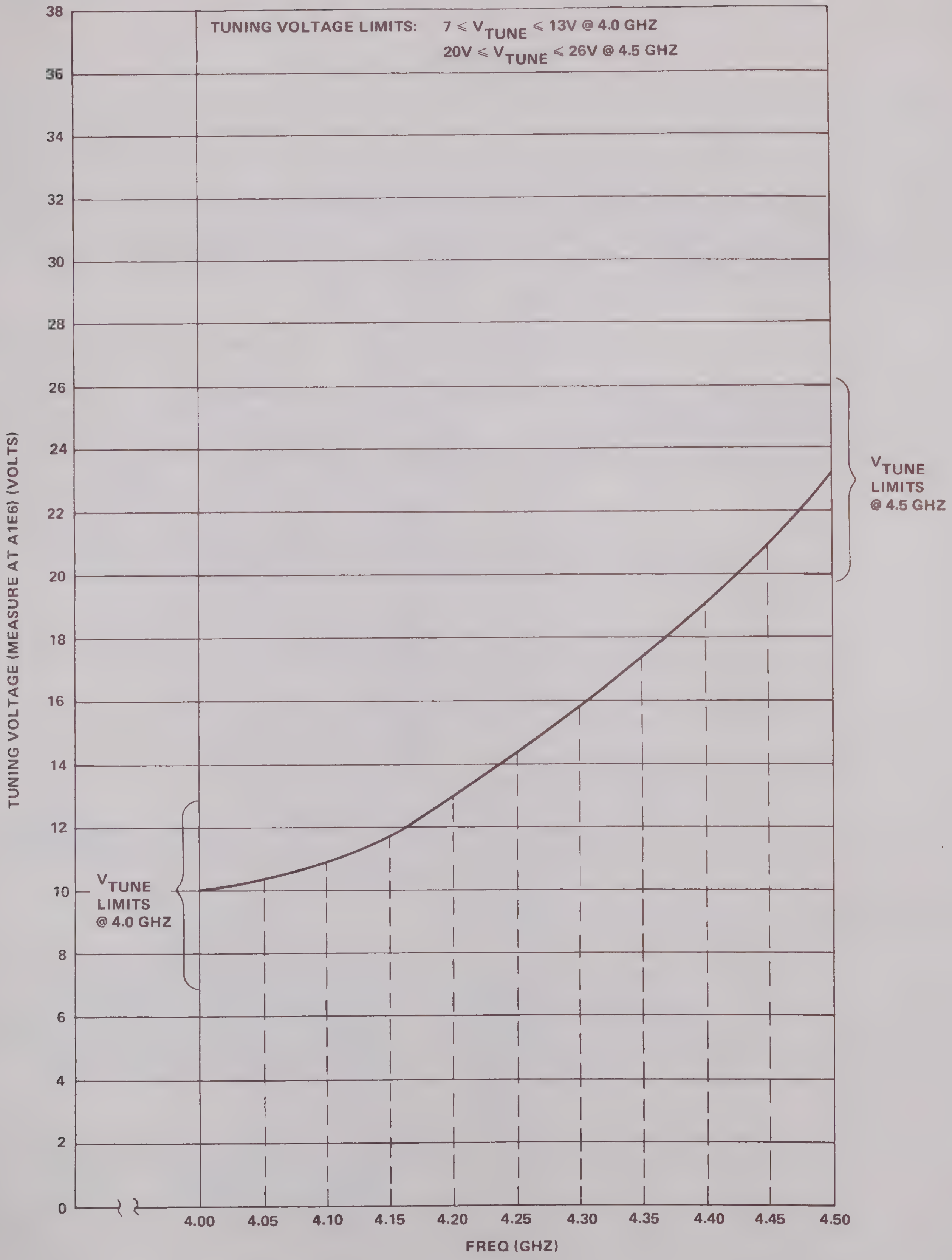


Figure 4-6. Typical Frequency vs. Tuning Voltage Curve for 7134

Table 4-6

Insertion Loss and Reflection Mode Problems*

Problem	Most Probable Causes
Errors greater than 3 db from actual insertion loss.	1. RF source subassembly defective (unreliable starting at selected frequency). Check: 1. Press FREQ DISP to determine problem frequency (error may be either maximum or minimum value). 2. Switch to "Single Frequency" mode. 3. Tune osc to problem frequency. 4. Press INS LOSS and observe repetitive measurement values on LCD (and analog meter indications) or Press INS LOSS . Connect an external detector to J1 and observe the detected voltage on an oscilloscope. The detector voltage should return to the same level whenever the "Osc On" LED is on. 2. Attenucoupler Test Port (J1) connector damaged. Check: 1. Visual inspection 2. Sweep return loss of J1 from 4.0 to 4.5 GHz and compare to 26 db specification. 3. Detector connector damaged. Check: same as 2. except spec is 15.6 db. return loss (20.8 dBR below 4 GHz)
Errors less than 3 db but greater then calculated value	1. Attenucoupler Test Port (J1) damaged Check: 1. Visual inspection 2. Sweep Return Loss of J1 from 4.0 to 4.5 GHz and compare to 26 db specification.

*Assuming neither mode is accurate.

Table 4-6 (Cont)

Problem	Most Probable Causes
Errors less than 3 db but greater than calculated values. (Cont)	2. Detector connector damaged. Check: 1. Visual inspection. 2. Sweep Return Loss of J1 from 4.0-4.5 GHz and compare to 15.6 db specification (20.8 dBR below 4 GHz)

Table 4-7

Reflection Mode Problems*

Problem	Most Probable Causes
Errors greater than calculated values.	Attenucoupler (A4) is defective. Check: Measure directivity of Isocoupler from 4.0 to 4.5 GHz (this may be done while the Attenucoupler is in the 7134 by placing the 7000A in Sweep Generator mode and using the supplied SHORT/OPEN to set a reference and a sliding termination for measurement. Connect the external detector to J2.)

*Assuming Unit is accurate in Insertion Loss mode.

SECTION V

MICROWAVE UNIT REPLACEABLE PARTS INFORMATION
NARDA Model 7134

5.1. INTRODUCTION.

This section provides ordering and repair service information, a list of suppliers and a replaceable parts list for Narda's Model 7134 Microwave Unit.

5.2. ORDERING INFORMATION.

To order replacement parts for the microwave unit contact the sales department at:

5.2.1. Narda Microwave Corp.
435 Mooreland Road
Hauppauge, NY 11788
Phone 516-231-1700 TWX 510-221-1867

5.2.2. When ordering replacement parts, supply the following information:

Model and serial number of the equipment.
Narda part number.
Reference designator.
Description.

5.2.3. When ordering components or parts not listed in Table 5-2 a complete description of the part including its function and location should be provided with the model number and serial number of the instrument. State the quantity required when ordering parts.

5.3. CUSTOMER REPAIR SERVICE.

Repair and recalibration of Narda products is performed by the customer service department at the Narda facility shown under paragraph 5.2. It is suggested that you contact Narda Microwave Corp. or your local Narda sales representative for shipping instructions, or with maintenance information requests.

5.4. LIST OF SUPPLIERS.

Table 5-1 identifies suppliers listed in numberical sequence according to their manufacturer's supply code number.

Table 5-1

Manufacturer's Supply Code Number List

Manufacturer's Supply Code	Name	Address
00779	Amp. Inc.	P.O. Boxy 3608 Harrisburg, Pa. 17105
01121	Allen-Bradley Co.	1201 South 2nd St. Milwaukee, Wis. 53204
01295	Texas Instruments Inc. Semiconductor & Components Division	13500 North Central Expressway Dallas, Tex. 75231
01884	Dearborn Electronics Div. Sprague Electric Co.	P.O. Box 1075 Longwood, Florida 32750
04713	Motorola Semiconductor Products Inc.	5005 East McDowell Road Phoenix, Ariz. 85008
05972	Loctite Corp.	75 N. Mountain Rd. Newington, Ct. 06111
06540	Amaton Elec. Div. Mite Corp.	466 Blake St. New Haven, Ct. 06515
10013	Cornell-Dubilier	Norwood, Mass.
13101	Thermalloy Co.	8717 Diplomacy Row Dallas, Tx 75247
15238	ITT Semiconductor	470 Broadway Lawrence, Mass 01841
15912	Ansley Elctronics Corp.	3208 Humboldt St. Los Angeles, Ca. 90031
17117	Electronic Molding Corp.	96 Mill St. Woonsocket, R.I. 02895

Table 5-1 (Cont)

Manufacturer's Supply Code	Name	Address
18324	Signetics Corp.	P.O. Box 9042 Sunnyvale, Ca 94086
22526	Berg Electronics Div. of E.I. du Pont de Nemours & Co. Inc.	New Cumberland, Pa. 17070
27014	National Semi-Conductor Corp.	2950 San Ysidro Way Santa Clara, Ca. 95051
27982	Semiconductor Circuits, Inc.	218 River St. Haverhill, MA 01830
45177	International Manufacturing Services Inc.	80 School House Lane Portsmouth, R.I. 02871
[illegible]384	Penn Engrg & Mfg Corp.	Doylestown, Pa 18901
56289	Sprague Electric Co.	North Adams, Mass. 01247
70318	Allmetal Screw Products Co.	Garden City, N.Y. 11530
71002	Birnbach Radio	435 Hudson St. New York, N.Y. 10014
72136	Electro Motive Mfg., Co. Inc.	The South Park and John St. Willimantic, Conn. 06226
73803	Texas Instruments Connector Systems	34 Forest St. Attleboro, Ma 02703
80031	Mepco, Inc.	Morristown, N.J. 07960
80294	Bourns, Inc. Dept. EM Trimpot Products Div.	1200 Columbia Ave. Riverside, Ca 92507
90484	ITT Suprenant Div.	172 Sterling St. Clinton, Ma 01510
91637	Dale Electronics Inc.	P.O. Box 609 Columbus, Nebr. 68601

Table 5-1 (Cont)

Manufacturer's Supply Code	Name	Address
91833	Keystone Electronics	49 Bleeker St. New York, N.Y.
95275	Vitramon	Box 544 Bridgeport, Ct. 06601
99899	Narda Microwave Corp.	435 Moreland Rd. Hauppauge, NY 11788

Table 5-2
Replaceable Parts List

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A1	PCB ASSY, MAIN CHASSIS	99899	418919	418919	1
	. SCR, FIL HD, #2-56 x 3/8 LG	70318	SCR. FIL HD 2-56 x 3/8 LG	70103020	2
	. SCR, FIL HD, #4-40 x 3/8 LG	70318	SCR. FIL HD 4-40 x 3/8 LG	70103031	1
A1C22	. CAP, 100PF, 5%	72136	DM15E101J0	80115027	1
A1C14,16	. CAP, 470PF, 5%	72136	DM15E471J0	80115043	2
A1C15	. CAP, 1000PF, 1000V	56289	35C74A	80122027	1
A1C25, C29	. CAP, .01UF, 25V	72982	5835-000Y5U103Z	80123006	2
A1C26, C33,C34	. CAP, 0.1UF, 25V	72982	5815-000Y5U104Z	80123009	3
A1C31	. CAP, 0.068 UF, 50V	95275	CK06BX683K	80187076	1
A1C23, C24,C28	. CAP, 47UF, 25V, 10%	56289	196D476X9035TE4	80261002	3
A1C20, C21	. CAP, 4.7 UF, 35V, 10%	56289	196D475X9035JE3	80261011	2
A1C13, C18	. CAP, 47 UF, 15V, 10%	56289	196D476X9020PE4	80261012	2
A1C19	. CAP, 47 UF, 6V, 10%	56289	196D476X9006JE3	80261013	1
A1C17	. CAP, 0.082 UF, 80V, 10%	56289	292P8239R8	80268008	1
A1J2	. CONN, HEADER, 10 PIN	00779	87588-1	81780003	1
A1J1	. CONN, RECEPTACLE, D TYPE	00779	206817	81806002	1
A1TP1, TP2,TP3	. HEADER ASSY, 1 POS	22526	65508-401	81814003	3
A1R38	. RES, 390 OHM, 1/4W, 5%	01121	RC07GF391T	83015039	1
A1R26	. RES, 470 OHM, 1/4W, 5%	01121	RC07GF471T	83015041	1
A1R25	. RES, 1.5K OHM, 1/4W, 5%	01121	RC07GF152T	83015053	1
A1R24, R27	. RES, 4.7K OHM, 1/4W, 5%	01121	RC07GF472T	83015065	1
A1R39	. RES, 0.10 MEG OHM, 1/4W, 5%	01121	RC07GF104T	83015097	1
A1R16	. RES, 200 OHM, 1/8W, 1%	80031	FE10 200 OHMS 1%	83049126	1
A1R22	. RES, 1K OHM, 1/8W, 1%	80031	FE10 1K OHMS 1%	83049192	1
A1R33	. RES, 4.02K OHM 1/8W, 1%	80031	FE10 4.02K OHMS 1%	83049250	1
A1R30	. RES, 4.75 OHM, 1/8W, 1%	80031	FE10 4750 OHMS 1%	83049257	1
A1R17	. RES, 5.11K OHM, 1/8W, 1%	80031	FE10 5.11K OHMS 1%	83049260	1

Table 5-2 (continued)

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A1R20	. RES, 5.62K OHM, 1/8W, 1%	80031	FE10 5.62K OHMS 1%	83049264	1
A1R31	. RES, 8.25K OHM, 1/8W, 1%	80031	FE10 8.25K OHMS 1%	803049280	1
A1R32	. RES, 10K OHM, 1/8W, 1%	80031	FE10 10K OHMS 1%	83049288	1
A1R35	. RES, 13K OHM, 1/8W, 1%	80031	FE10 13K OHMS	83049299	1
A1R15	. RES, 14.7K OHM, 1/8W, 1%	80031	FE10 14.7K OHMS 1%	83049304	1
A1R21	. RES, 15K OHM, 1/8W, 1%	80031	FE10 15K OHMS 1%	83049305	1
A1R10, R11,R36	. RES, 22.6K OHM, 1/8W, 1%	80031	FE10 22.6K OHMS 1%	83049321	3
A1R18	. RES, 26.1K OHM, 1/8W, 1%	80031	FE10 26.1K OHMS 1%	83049327	1
A1R12, R19	. RES, 42.2K OHM, 1/8W, 1%	80031	FE10 42.2K OHMS 1%	83049347	2
A1R9, R14	. RES, 46.5K OHM, 1/8W, 1%	80031	FE10 47.5K OHMS 1%	83049352	2
A1R13	. RES, 56.2K OHM, 1/8W, 1%	80031	FE10 56.2K OHMS 1%	83049359	1
A1R28	. RES, 0.499 OHMS, 2W, 5%	91637	RWR-80S0R50FM	83245002	1
A1R34	. POT, CERMET, 2K	80294	3299W-1-202	83246002	1
A1R29, R37	. POT, CERMET, 10K	80294	3299W-1-103	83246004	2
A1R23	. RES, VAR, 5K OHM	80294	83C1D-E12-J13	83266000	1
A1U4	. IC, MC4011B	04713	MC14011BCP	84779000	1
A1U2	. IC, LF355N	27014	LF 355N	84783000	1
A1U3	. IC, MC1723CL	04713	MC1723CL	84807000	1
A1U1	. IC, LM343H	27014	LM 343H	84812000	1
A1CR2, CR3	. DIODE, IN4148	15238	1N4148	84830000	2
A1E1,2,3, 5,6,7,8,9	. TERMINAL, TUBULAR	91833	1562-2	87118002	8
A1Q6	. TRANSISTOR, 2N4124	56289	2N4124	89018036	1
A1Q5	. TRANSISTOR, 2N4126	56289	2N4126	89018037	1
A1Q4	. TRANSISTOR, MJE520	04713	MJE 520	89045000	1
	. WASHER, COMPRESSION	04713	B522000F006	89045001	1
	. WASHER, MICA	04713	B56200F003	89045002	1
A1XU2	. IC SOCKET, 8 PIN	73803	C93-08-10	89075000	1
A1XU3, XU4	. IC SOCKET, 14 PIN	73803	C93-14-10	89075001	2
A1XU5	. IC SOCKET, 16 PIN	73803	C93-16-10	89075002	1
A1XU6	. IC SOCKET, 20 PIN	73803	C93-20-10	89075003	1

Table 5-2 (continued)

REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
A1XU1	. IC SOCKET, 8 PIN	17117	7008-362-10	89080002	1
A1XQ4	. COOLER, TRANSISTOR	13101	6073B-75-SQX .375 High	89539000	1
	. WASHER, FLAT, #	70318	MS5795802	515795802	4
	. WASHER, FLAT, #4	70318	MS5795803	515795803	1
	. LOCKWASHER, #2	70318	MS5338134	535338134	2
	. NUT, HEX, #2-56	70318	MS5649003	535649003	2
	. NUT, HEX, #4-40	70318	MS5649007	535649007	1
A4	ATTENU-COUPLER	99899	419622	419622	1
MP20	INSULATOR, FISH PAPER	99899	418822	48822 A	1
	WASHER NYLON #4	71002	6593	71006002	1
MP17	WASHER, SHOULDER	71002	6592	71046001	2
MP1	TOP COVER, INSEP ASSY	99899	213330	213330	1
	. STDF SELF CLINCH 6-32X3/8	46384	CSOS-632-6	72036001	4
MP2	BOTTOM PLATE, INSEP ASSY	99899	213339	213339	1
	. RETAINER, PANEL SCR	06540	6251A-SS-0632-7	70544000	2
W1	CABLE ASSY	99899	319339	319339	1
	SHORT, OPEN	99899	Model 231-416	381441	1
MP8	SIDE EXPANDER	99899	318558	318558	2
MP9	FRONT PANEL	99899	321067	321067	1
MP4	REAR PANEL	99899	319340	319340	1
A3	RF SOURCE ASSY-SPARE PART #W/PROM	99899	321073	321073	1
A1U5	. IC, PROM, PROGRAMMED	18324	IC N82S123B	84833000	1
MP18	CONTACT & BRKT SUB-ASSY	99899	319330	319330	1
	LOCTITE	05972	GRADE C	410187	
	EASTMAN 910	99899	410188	410188	
	379BNM, TERMINATION	99899	Model 379BNM	413855	1
MP9	SCREW, CAPTIVE	99899	418223	418223	2
	SCREW LOCK ASSY	15912	609-005	81811000	1
CR1	LED	99899	84831000	83831000	1
FL1	LOW PASS FILTER, 4.6 GHZ		86979005	86979005	1
MP10	SPRING, COMPRESSION	99899	94012000	94012000	2
MP11	SPACER	99899	95630003	95630003	4
MP12	FEET	99899	95630015	95630015	4
MP24	WASHER, FLAT, #2	70318	MS15795802	515795802	4
MP21	WASHER, FLAT, #4	70318	MS15795803	515795803	4
MP7	WASHER, FLAT, #4	70318	MS15795804	515795804	4
MP22	LOCK WASHER, INT, #4	70318	MS35333070	535333070	2
	LOCKWASHER, #2	70318	MS35338134	535338134	2
MP6	LOCKWASHER, #4	70318	MS35338135	535338135	4
MP25	LOCK NUT ASSY	99899		419064	1
MP16	FLAT WASHER #6		MS15795804	515795804	4

Table 5-2 (continued)

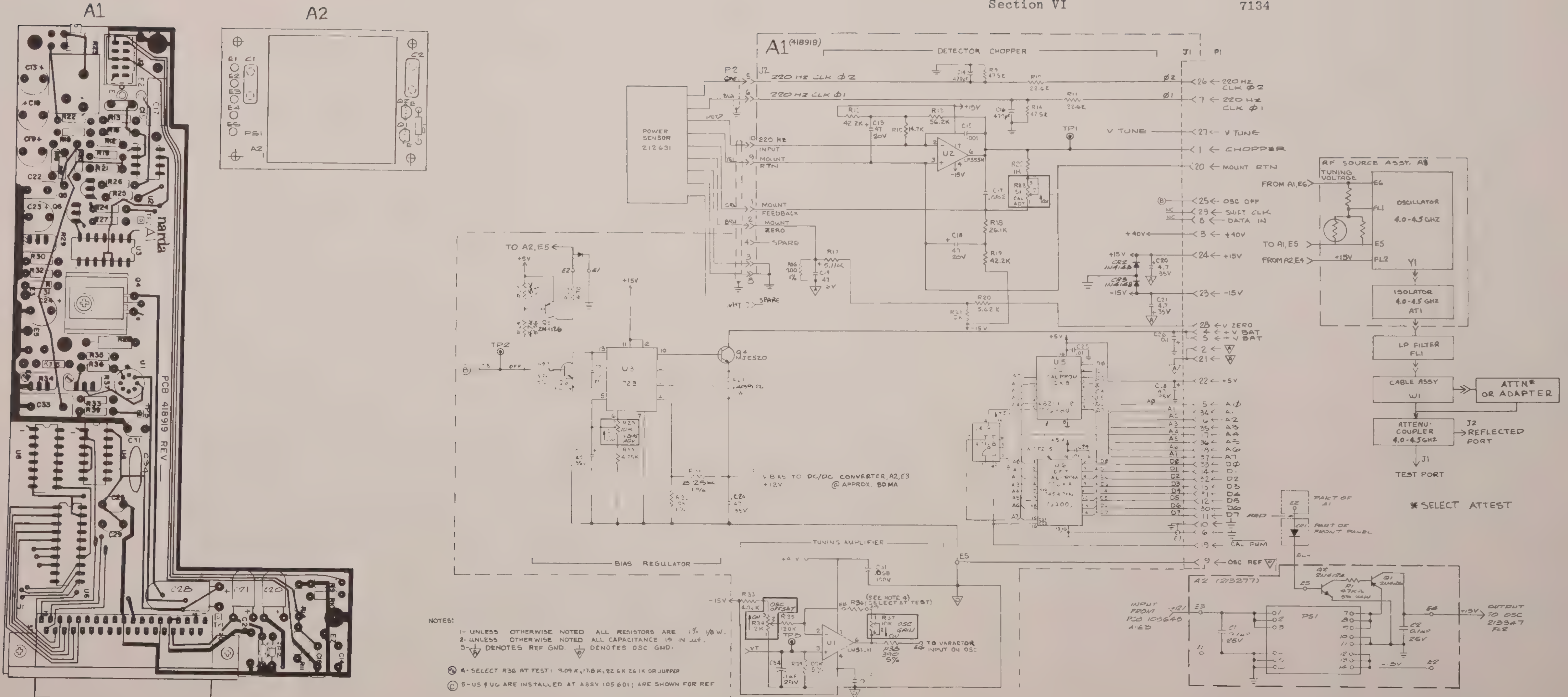
REF. DESIG.	1 2 3 4 5 6 7 DESCRIPTION	MFG. CODE IDENT.	MFG. PART NO.	NARDA PART NO.	QTY
MP14	LOCKWASHER, #6	70318	MS5338136	535338136	6
MP26	SCR, #2-56X1/4LG.	70318	MS1957003	55197003	2
MP23	SCR, PAN HD, #2-56X7/16LG.	70318	MS51957006	551957006	2
MP3	SCR, PAN HD, #4-40 X 1/4 LG.	70318	MS51957013	551957013	4
MP15	SCR, PH HD, #6-32 X 3/8 LG.	70318	MS51957028	551957028	4
MP13	SCR. PAN HD, #6-32 X 2 LG.	70318	MS51957038	551957038	4
	. SCR, PAN HD, #6-32X2 1/2LG.	70318	SCREW, CRES CROSS REC PAN HD #6-32X2 1/2	70126001	2
A2	PWR SENSOR ASSY AND PROM } SPARE PART	99899	319085	319085	1
A2A1	. PCB ASSY, PWR SENSOR	99899	212632	212632 D	1
A2C6	. . CAP, 75PF, 5%	72136	DM15E750J0	80115024 G	1
A2C5	. . CAP, 0.001UF, 500V	10013	BYA 10D1	80128001 C	1
A2C4	. . CAP, 0.01UF, 500V	10013	BYA 6S1	80128004 C	1
A2C7	. . CAP, 22UF, 15V	56289	196D226X9015A1	80230034 B	1
A2C2,C3	. . CAP, 2.2UF, 50V	01884	LP88A1A225K	80274001 A	2
A2R6	. . RES, 200 OHM, 1/8W, 1%	80031	FE10 200 Ω ,1%	83049126 F	1
A2R7	. . RES, 301 OHM, 1/8W, 1%	80031	FE10 301 Ω ,1%	83049143 F	1
A2R8	. . RES, 499 OHMS, 1/8W, 1%	80031	FE10 499 Ω ,1%	83049164 H	1
A2R5	. . RES, 13K OHMS, 1/8W, 1%	80031	FE10 13K Ω ,1%	83049299 F	1
A2R2,R3	. . RES, 16 OHMS	45177	IMS 3B-2 -16	83267001 C	2
A2R4	. . RES, 10K OHMS	45177	IMS 3B-2 -10K	83267002 C	1
A2CR1, CR2	. . DIODE, IN4148	15238	IN4148	84830000 A	2
A2E1-E11	. . TERMINAL, TUBULAR	91833	1562-2	87118002 A	9
A2Q3	. . TRANSISTOR, 2N3117	27014	2N3117	89018011 W	1
A2Q1,Q2	. . TRANSISTOR, 2N5638	04713	2N5638	89018103 T	2
	. HOUSING, FRONT ASSY	99899	212713	212713 C	1
	. . HOUSING, FRONT	99899	212714	212714 C	1
	. HOUSING, REAR	99899	212715	212715 C	1
A2U6	. IC, PROM, PROGRAMMED, 745471N	01295	SN745471N	8483	1
MP19	STRAIN RELIEF BUSHING	99899	72519000	72519000	1
A2	. PCB ASSY, DC-DC CONVERTER	99899	213377	213377	1
	. BRACKET, PCB INSEP ASSY	99899	319325	319325	1
A2,Q1	. . TRANSISTOR, 2N4126	56289	2N4126	89018037	1
A2,Q2	. . TRANSISTOR, 2N4124	56289	2N4124	89018036	1
A2,PS1	. DC/DC CONVERTER, 15 VOLT	27982	30012-15 D100	84118001	1
A2,C1,C2	. . CAP, 0.1 MG, 25V	72982	5815-000Y5U104Z	80123009	2
A2,R1	. . RES, 4.7K OHMS, 1/4W, 5%	01121	RC07GF472T	83015065	1
A2,E1-E5	. . TERMINAL, TUBULAR	91833	1562-2	87118002	5

SECTION VI

MICROWAVE UNIT SCHEMATIC AND PARTS LOCATION DRAWINGS
NARDA Model 7134

6.1. INTRODUCTION.

This section provides schematic, parts location and exploded view drawings of the Model 7134 Microwave Unit.


A1
A2
PCB 418919 REV
narda
A1 (418919)
DETECTOR CHOPPER
POWER SENSOR 212631
220 HZ CLK Φ2
220 HZ CLK Φ1
V TUNE
CHOPPER
MOUNT RTN
OSC OFF
SHIFT CLK
DATA IN
+40V
+15V
-15V
V ZERO
+V BAT
+5V
CAL PRM
OSC REF
BIAS REGULATOR
TUNING AMPLIFIER
V BIAS TO DC/DC CONVERTER, A2, E3 +12V @ APPROX. 80 MA
TO VARACTOR INPUT ON OSC
(SEE NOTE 4) R36 (SELECT AT TEST)
RF SOURCE ASSY. A3
TUNING VOLTAGE
OSCILLATOR 4.0-4.5 GHZ
FROM A1, E6
TO A1, E5
FROM A2, E4
ISOLATOR 4.0-4.5 GHZ AT1
LP FILTER FL1
CABLE ASSY W1
ATTN* OR ADAPTER
ATTENU-COUPLER 4.0-4.5 GHZ
J2 REFLECTED PORT
J1 TEST PORT
*SELECT AT TEST
A2 (213277)
INPUT FROM P/O 105645 A-E3
OUTPUT TO OSC 213347 FL2
PART OF A1
PART OF FRONT PANEL

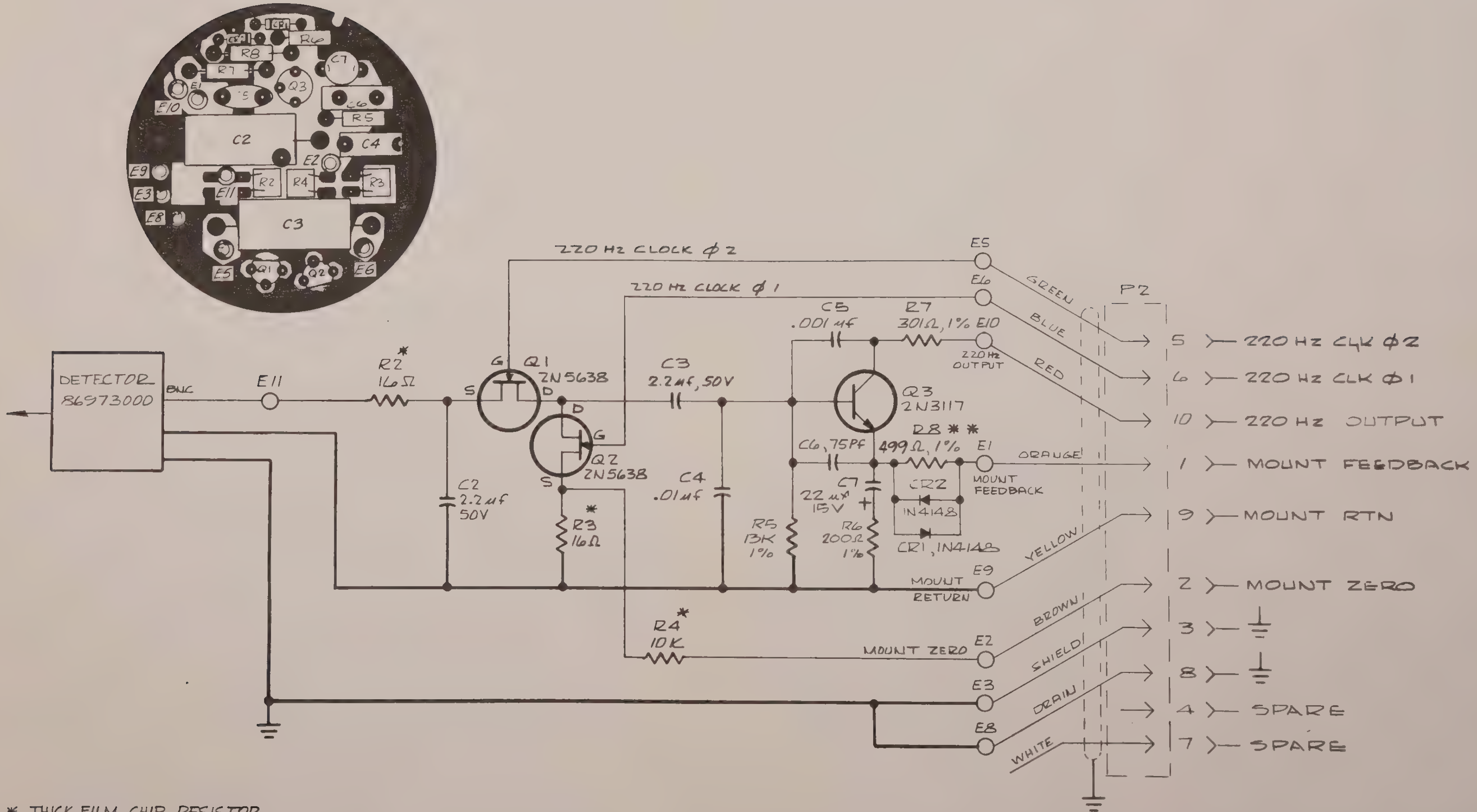
NOTES:

1- UNLESS OTHERWISE NOTED ALL RESISTORS ARE 1% 1/8 W.
2- UNLESS OTHERWISE NOTED ALL CAPACITANCE IS IN µf.
3- Ⓡ DENOTES REF GND. Ⓞ DENOTES OSC GND.

④ 4- SELECT R36 AT TEST: 9.09 K, 17.8 K, 22.6K 26.1K OR JUMPER

Ⓒ 5- U5 & U6 ARE INSTALLED AT ASSY 105601; ARE SHOWN FOR REF

Figure 6-1. Schematic and Parts Location Drawing Model 7134 Microwave Unit


CR1
R6
R8
C7
R7
E1
Q3
E10
5
C6
R5
C2
C4
E2
E9
R2
R4
R3
E3
E11
E8
C3
E5
Q1
Q2
E6
DETECTOR 86973000
BNC
E11
R2 *
16Ω
G
Q1
2N5638
S
D
D
G
Q2
2N5638
S
C2
2.2μf
50V
R3 *
16Ω
220 Hz CLOCK φ2
220 Hz CLOCK φ1
E5
E6
C3
2.2μf, 50V
C4
.01μf
C5
.001μf
R7
301Ω, 1% E10
220 Hz OUTPUT
Q3
2N3117
R8 **
499Ω, 1%
E1
C6, 75PF
C7
22μf
15V
R5
13K
1%
R6
200Ω
1%
CR2
1N4148
CR1, 1N4148
MOUNT FEEDBACK
MOUNT RETURN
E9
R4 *
10K
MOUNT ZERO
E2
E3
E8
GREEN
BLUE
RED
ORANGE
YELLOW
BROWN
SHIELD
DRAIN
WHITE
P2
5 220 Hz CLK φ2
6 220 Hz CLK φ1
10 220 Hz OUTPUT
1 MOUNT FEEDBACK
9 MOUNT RTN
2 MOUNT ZERO
3
8
4 SPARE
7 SPARE

* THICK FILM CHIP RESISTOR

** R8 IS EITHER 499Ω OR 618Ω, 1%

Figure 6-2. Schematic and Parts Location Drawing Power Sensor Assembly PC Board

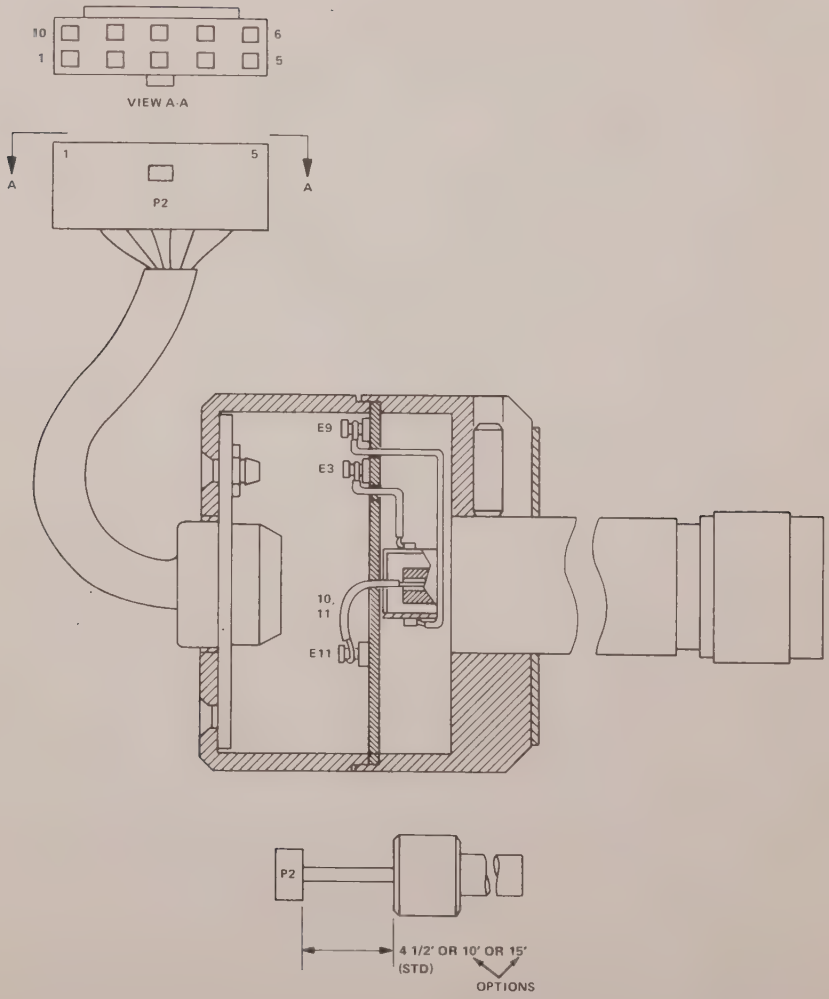

10
6
1
5
VIEW A-A
1
5
A
A
P2
E9
E3
10,
11
E11
P2
4 1/2' OR 10' OR 15'
(STD)
OPTIONS

Figure 6-3. Parts Location Drawing Power Sensor Assembly

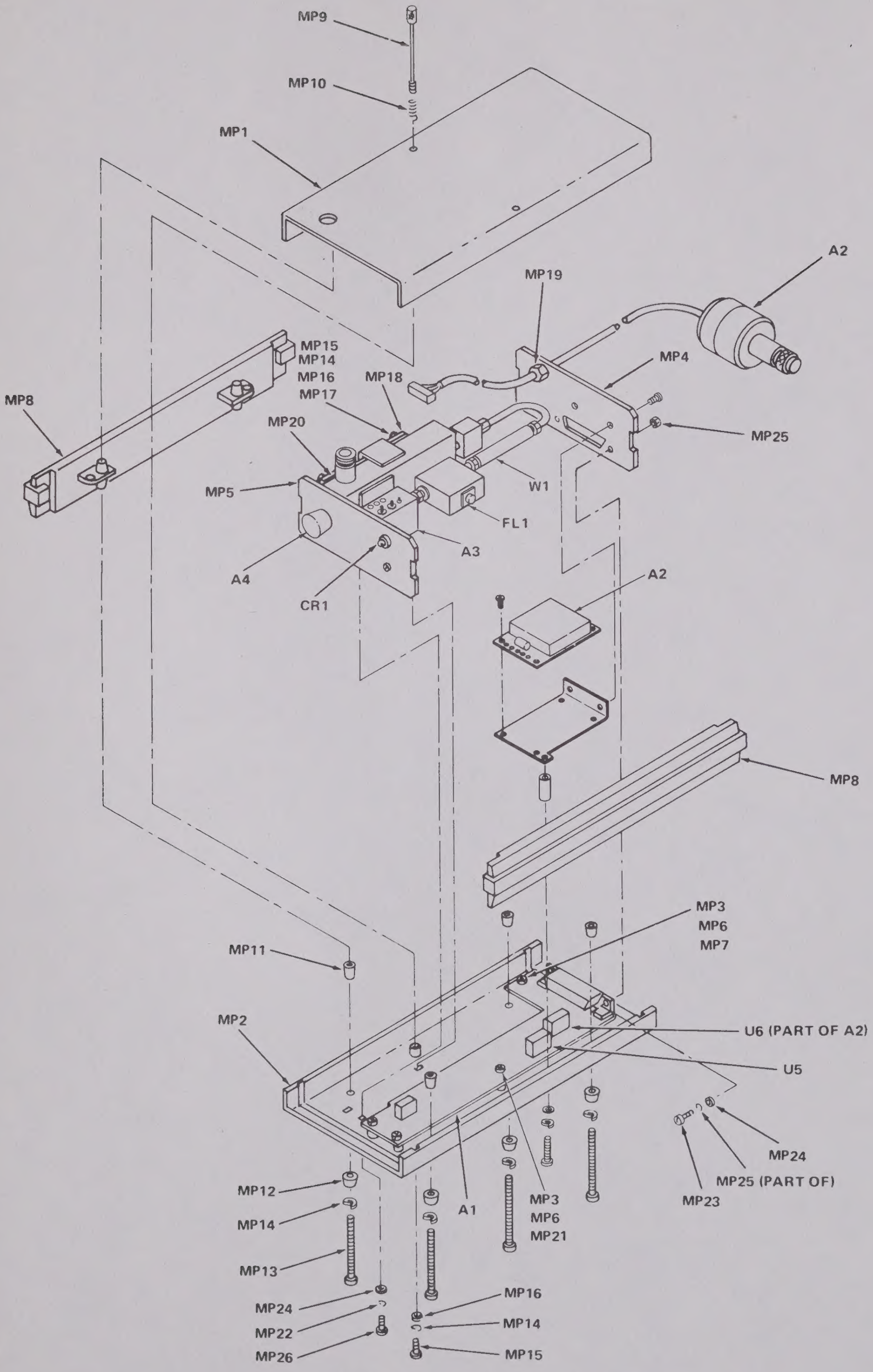

MP9
MP10
MP1
A2
MP19
MP15
MP14
MP16
MP17
MP18
MP4
MP8
MP20
MP25
MP5
W1
FL1
A3
A4
CR1
A2
MP8
MP3
MP6
MP7
MP11
MP2
U6 (PART OF A2)
U5
MP24
MP25 (PART OF)
MP23
MP12
MP14
A1
MP3
MP6
MP21
MP13
MP16
MP24
MP22
MP14
MP26
MP15

Figure 6-4. Exploded View Model 7134 Microwave Unit

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